Deloro Mine Site Cleanup Project

Draft Cleanup Plan
Summary

November 5, 2004

Protecting our environment. Ontario

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Ontario Ministry of the Environment

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Preface

This document summarizes the full technical report of the draft cleanup plan for the Deloro Mine Site, created by the Ministry of the Environment's (MOE) engineering consulting firm CH2M HILL Canada Limited (CH2MHILL). This document is intended as a generalized draft for discussion purposes only. The full draft integrated cleanup plan (titled, *Deloro Mine Site Cleanup, Integrated Cleanup Plan – Draft Report*) is available for public review at: www.ene.gov.on.ca, or by contacting Heather Hawthorne, Ministry of the Environment, 133 Dalton Avenue, Kingston, Ontario. Phone: 613-548-6927. The draft integrated cleanup plan will be finalized after public consultation.

Introduction and Background

The Deloro Mine Site Cleanup Project is a multimillion dollar initiative of the Ontario Ministry of the Environment to clean up the abandoned mining, refining, and manufacturing site at Deloro, Ontario. The ministry assumed responsibility for this site in 1979 as remediator of last resort when the site owner failed to comply with ministry orders to stop pollution. The ministry has made significant progress in dealing with the complex and multifaceted environmental issues at the site, and is now consulting on the draft plan to finish the cleanup.

Location

The Deloro Mine Site is in Eastern Ontario about 200 km southwest of Ottawa and 65 km east of Peterborough. The site sits along the banks of the Moira River, beside the eastern boundary of the Village of Deloro (pop. 180).

History

The Deloro mine was the site of nearly 100 years of mining, refining, and manufacturing. It has a rich past and an important place in the history of industry in Canada. Mining at the site began around 1867, and was part of the Madoc Gold Rush, the first discovery of gold in Ontario. Operations at the site evolved over the next century to include not only mining and refining of gold, but also smelting and refining of a number of other elements including arsenic, silver, and cobalt.

The Deloro Mining and Reduction Company was the first in the world to produce cobalt commercially. The company was also a leading producer of stellite, a cobalt-chromium-tungsten alloy. Concentrates from uranium extraction were imported to the site and further processed to extract cobalt and arsenic.

Deloro was a pioneer producer of arsenic-based pesticides, which were produced from the by-products of smelting operations and continued as a main activity at the site until the market collapsed in the late 1950s.

Ownership of the property now known as the Deloro Mine Site was transferred through a succession of entrepreneurs including the Gatling Gold and Silver Mining Company, Canada Consolidated Mining Company, Canadian Goldfields Limited, and the Deloro Mining and

Reduction Company, (which later changed its name to the Deloro Smelting and Refining Company).

In 1961, the Deloro Smelting and Refining Company closed its plant. In 1970, British Oxygen bought Deloro Stellite (a division of the Deloro Smelting and Refining Company). The sale did not include the mine site property, which was transferred to Erickson Construction Company Limited, a subsidiary of M.J. O'Brien. In 1979 Erickson Construction Company Limited abandoned the site. The Ontario Ministry of the Environment assumed responsibility for the environmental cleanup of the site as "remediator of last resort" The property escheated to the provincial Crown in 1987.

Environmental Legacy

At the time the refining and manufacturing operations were shut down in 1961, nearly a century's worth of hazardous by-products and residues (a complex blend of toxic compounds; metals like cobalt, copper, nickel; and low-level radioactive wastes) remained on the property. Arsenic is the main contaminant of concern. Low-level radioactive slag and tailings were produced as a result of the re-refining of by-products from uranium refining. All these materials caused significant environmental impact at the site, including contamination of the site's soil, sediment, surface water and groundwater. In addition to chemical concerns the site was scattered with abandoned mine workings.

Ministry of the Environment Accomplishments

The Ontario Ministry of the Environment (MOE) took control of the site in 1979 when the site owner failed to comply with Environmental Protection Act cleanup orders. Since that time the ministry has spent more than $20.5 million on this project on actions that include:

- Construction of an Arsenic Treatment Plant to treat contaminated groundwater (the plant removes about 99.5 per cent of the arsenic from the contaminated groundwater it treats);
- Establishment of an extensive ground and surface water monitoring network
- Construction of an on-site laboratory to analyze ground and surface water samples
- Locating and sealing abandoned mine shafts
- Demolishing derelict buildings
- Covering eight hectares (ha) of red mud tailings with crushed limestone to eliminate wind and surface water erosion and to address chemistry related issues
- Fencing the entire site to discourage trespassing
- Conducting two off-site assessments: *Deloro Village Environmental Health Risk Study*; and the *Moira River Study* to assess potential off-site impacts to people and the environment.

As a result of ministry actions at the site, the arsenic loading to the river has been reduced by more than 80 percent. For more information on each of these activities, refer to Appendix D, or to the Deloro Web page on the ministry's Web site at www.ene.gov.on.ca.

Finishing the cleanup of the site

Despite significant progress, more work is needed to finish the cleanup and secure the site for the long-term. In April 1997, CH2M HILL Canada Limited (CH2MHILL) was hired by the ministry to develop and implement the plan that would finish the cleanup of the former mining and industrial complex.

Cleanup Objectives, Approach and Criteria

This section reviews the process used in the development of the draft cleanup plan for the Deloro Mine Site and includes information on the objectives for the site cleanup, as well as cleanup approach and criteria.

Deloro Mine Site Cleanup Project – Overall Objective

The overall objective of the Deloro Mine Site Cleanup Project is to finish the cleanup of this abandoned mining and industrial complex, by isolating and containing wastes, and engineering the site to be safe for people and the environment for hundreds of years.

Additional cleanup objectives

Additional cleanup objectives were developed to ensure the draft cleanup plan:

- Manages wastes over the smallest possible area (reduces the surface area of the wastes)
- Secures the site for the long-term
- Reduces the loading of arsenic and other contaminants to the Moira River
- Complies with appropriate regulations and policy
- Satisfies the general intent of the Mining Act
- Prioritizes implementation of cleanup action according to risk reduction
- Minimizes long-term operation and maintenance of site facilities
- Restores the site to reflect its natural surroundings

These objectives are consistent with cleanup practices elsewhere in the province.

Division of Areas

The overall Deloro Mine Site property, which includes former mine workings, mineral processing facilities and tailings disposal areas, is approximately 202 hectares in area. To facilitate development of the cleanup plan, the Deloro Mine Site was conceptually divided into four areas based on historical land use and waste disposal practices. These areas are:

- Industrial Area - where smelting and refining of various ores took place
- Mine Area - on both the east and west sides of the Moira River, where mining took place
- Tailings Area - where by-products of the production phase were stored
- Young's Creek Area - which has been impacted from historical releases from the Tailings Area

Quick facts about the Deloro Mine Site

Size: About 202 hectares (ha)

Contaminants of Concern:

- Arsenic, the main contaminant of concern
- Cobalt, copper, nickel
- Low-level radioactive material (represents 2-6 per cent of waste at the site)

Other Materials to be Managed:

- Refining slag
- Mine tailings
- Laboratory wastes
- Demolished materials

Volume of Wastes: About 650,000 cubic metres (m^3)

A cleanup strategy has been developed for each area of the site to deal with each area's unique environmental issues.

Area-specific closure objectives

For each area of the mine site specific closure objectives were developed to help ensure a successful cleanup. Some of these objectives are outlined below.

Area	Closure Objectives
Industrial Area	Reduce low-level radioactivity to background levels
	Remove wastes from the 100-year floodplain
	Consolidate and isolate wastes from the environment
	Ensure engineered facilities are designed to be safe for hundreds of years
Mine Area	Consolidate highly contaminated materials
	Restore area to blend in with natural surroundings
Tailings Area	Contain tailings for the long-term
	Manage contaminated seepage
	Revegetate the area to match natural surroundings
Young's Creek Area	Prevent increased contaminant loading to the Moira River
	Ensure engineered facilities are designed to be safe for hundreds of years
	Restore area to blend in with natural surroundings

Cleanup Approach

Strategic direction: onsite management of wastes through isolation and containment.

The Ministry of the Environment decided in the early 1990s, that the most viable solution for the management of contamination at the Deloro Mine Site is onsite management through isolation and containment techniques.

Wastes will be isolated and contained onsite following the Site Specific Risk Assessment (SSRA) approach, under MOE's *Guideline for Use at Contaminated Sites in Ontario* (1997). Risk assessment is a scientific technique which estimates the risk posed to people, plants, wildlife and the natural environment from exposure to a contaminant. Results of the SSRA are used to determine how much cleanup needs to happen before the site is considered safe for people and the environment.

For more detailed information on the Site Specific Risk Assessment approach, and the ministry's guidance documents, please refer to the ministry's Web site: www.ene.gov.on.ca. The SSRA for the Deloro Mine Site is currently in development. The results will be used to establish the extent of the cleanup.

Cleanup Criteria

In order to meet the objectives of site cleanup, several specific, measurable criteria, or targets for cleanup were developed under three main categories: physical, chemical and radiological. The cleanup criteria were based on a detailed review of the applicable federal and provincial legislation, guidelines and policies and the application of engineering principles. Each of these criteria had to be met in the development of the cleanup plan.

Physical Cleanup Criteria

Design Service Lives – The cleanup plan had to ensure that engineered facilities used to isolate and contain wastes are designed to be safe for hundreds of years. The chart below outlines the design life of key engineered components proposed for the Deloro Mine Site:

Engineering Feature	Design life
Primary leachate collection system	greater than 100 years
Compacted clay liners	thousands of years
Manufactured (geomembrane) liners in contact with raw leachate	150 years
Manufactured (geomembrane) liners in secondary system	greater than 200 years
Secondary leachate treatment system	1,000 years
Tertiary leachate collection system	greater than 1,000 years

Design Floods – The cleanup plan had to ensure all contaminated materials within the 100-year floodplain along the Moira River are removed. This is the area that would likely be affected in

the event of a storm resulting in major flooding. Those contaminated materials outside the floodplain must be isolated from the environment.

Seismic Considerations – The cleanup plan had to ensure engineered facilities were strong enough to endure the maximum earthquake activity possible for the area.

Perpetual Disruptive Forces - The cleanup plan had to be designed to minimize, or eliminate the effects of perpetually disruptive forces, including: wind erosion, water erosion due to flooding, ice accumulation, frost penetration, and weathering. The plan also had to be designed to minimize the possibility of root penetration, burrowing animals and people.

Chemical Cleanup Criteria

Human Health - The cleanup must ensure protection of human health from cancer-causing and non-cancer causing materials.

Aquatic - The cleanup must ensure protection of aquatic species. To that end, the cleanup must be designed to ensure the current/interim Provincial Water Quality Objectives (PWQO) are met, on average, at all locations in the Moira River and Young's Creek at Highway # 7. To ensure this, the cleanup plan must be designed to achieve a further 90 percent reduction in arsenic discharge to the Moira River.

The PWQO will ideally be met at all locations in the Moira River and Young's Creek within the site boundaries to the extent possible. The Moira River and Young's Creek will be considered a mixing zone north of Highway # 7. Conditions in the mixing zone may exceed the PWQO but must not be acutely toxic to aquatic life or cause irreversible ecological damage. The Moira River and Yong's Creek intersection points with Highway # 7 are the key reference points for meeting the current/interim PWQOs.

Terrestrial - The cleanup must result in the long-term protection of terrestrial habitat.

Radiological Cleanup Criteria

The cleanup plan must reduce low-level radiation to background levels at ground surface.

For more information on closure criteria, please see: *Deloro Mine Rehabilitation Project - Development of Closure Criteria, October 1998.*

Developing the draft cleanup plan

This section outlines the process followed in the development of the draft cleanup plan for the Deloro Mine Site, including an explanation of the various scientific and engineering reports created in the process.

The development of a cleanup plan is a complex process requiring the specialized and combined expertise of engineers, hydrogeologists, scientists, biologists, risk assessors, and toxicologists.

An extensive team of technicians, scientists and engineers from CH2MHILL developed the draft cleanup plan. The plan was also reviewed by scientific and engineering experts in the Ministry of the Environment, and by the ministry's three project liaison committees (the Public Liaison Committee, the Technical Liaison Committee, and the MOE Technical Committee).

Development of a comprehensive cleanup plan for a site as large and complex as the Deloro Mine Site required a very detailed understanding of the site itself, including the exact nature, extent, and location of contamination, as well as a detailed understanding of ground and surface water flow, 100-year floodplain mapping, site geology, and ecology. Outlined below is a condensed summary of steps followed in the development of the plan.

Technical investigations – involves scientific analysis necessary to define the extent and nature of contamination; to determine current environmental conditions (i.e. soil, surface water, groundwater, air, human health risk, and ecologic conditions). Technical investigations also determine the feasibility of various cleanup options. CH2MHILL conducted a number of technical investigations to address outstanding site-wide and area-specific questions. For a partial list of those investigations see Appendix E.

Alternatives reports -- As part of the development of the cleanup plan, CH2MHILL evaluated a broad range of conceptual cleanup methods (rehabilitation alternatives) and identified a recommended alternative for each of the four areas of the mine site. For a detailed review of the alternatives considered for each area of the site, please refer to the rehabilitation alternatives reports on the ministry's Web site, www.ene.gov.on.ca :

- *Deloro Mine Site Cleanup - Industrial Area Rehabilitation Alternatives, December 2003*
- *Deloro Mine Site Cleanup - Mine Area Rehabilitation Alternatives, October 2003*
- *Deloro Mine Site Cleanup - Tailings Area Rehabilitation Alternatives, October 2003*
- *Deloro Mine Site Cleanup - Young's Creek Area Rehabilitation Alternatives, May 2003*

Closure plans – Closure plans take the recommended cleanup alternative to the next level of development, and include a preliminary engineering design for each area. The closure plans listed below are found on the ministry's Web site, www.ene.gov.on.ca :

- *Deloro Mine Site Cleanup – Industrial Area Closure Plan, August 2004*
- *Deloro Mine Site Cleanup – Mine Area Closure Plan, August 2004*
- *Deloro Mine Site Cleanup – Tailings Area Closure Plan, August 2004*
- *Deloro Mine Site Cleanup – Young's Creek Area Closure Plan, August 2004*

The Draft Cleanup Plan – The draft Cleanup Plan integrates the four area-based Closure Plans to provide a comprehensive summary of the cleanup efforts proposed for the entire Deloro Mine Site.

Environmental Legacy – In detail

Waste Volume Inventory

Technical investigations allowed the consultant to more accurately determine the nature and extent of contamination. The chart below summarizes the volume of waste material at the Deloro Mine Site. The main contaminants of concern at the site are arsenic, cobalt, copper, and nickel. Low-level radioactive waste is also a contaminant of concern.

Area	**Approx. size of area – hectares (ha)**	**Waste Type**	**Approx. Volume cubic metres (m^3)**
Industrial Area	25	Highly contaminated waste (arsenic, including calcium arsenate/arsenite stockpile and gold mine tailings) and mixed radioactive slag and radioactive tailings	262,000
		Radioactive and non-radioactive slag	39,500
		Demolition ruins	4,000
Main Mine Area and Remote Mine Area	117	Highly contaminated waste and low-level radioactive slag	32,500
Tailings Area	13	Red mud tailings	45,000
Young's Creek Area (onsite)	47	Contaminated sediments (some radioactive) and contaminated deeper soils	199,000
Young's Creek Area (offsite)	19	Contaminated shallow sediments	68,000
		Total	**Approx. 650,000**

Low-Level Radioactive Material

About two to six per cent of the total waste at the Deloro Mine Site is contaminated with low-level radioactivity. Operations at the Deloro Mine Site in the 1930s to 1950s involved the reprocessing of uranium and radium (Ra-226) residues from the Eldorado refinery in Port Hope for the recovery of cobalt, other metals, and arsenic. The nature and extent of low-level

radioactive materials at the site was summarized in a report titled *Deloro Mine Site Cleanup Project - Extent and Character of Radioactive Materials, June 1999.*

Radioactivity 101 – There are three types of radiation emitted from the naturally occurring radioactivity present in all rocks and soils: alpha, beta and gamma radiation. Alpha radiation is a particle that is readily stopped in air or by a sheet of paper. Beta radiation is a smaller particle that travels further in air but is also readily stopped by 1-2 cm of water or by the near-surface of the body. Gamma radiation is a form of electromagnetic radiation, similar to light or radiowaves, but of greater energy and is more penetrating than either alpha or beta radiation.

Uranium is a naturally occurring radioactive element that is widely distributed on earth.

Radon is a gas that is the naturally occurring by-product of uranium and radium. Since all soils contain some uranium and radium, our atmosphere and our homes all contain radon.

Units of measurement - The S.I. (Système International de Unités) unit of dose is the sievert (Sv) or millisievert (mSv), 1 mSv = 1,000 µSv. The S.I. unit of radioactivity is the Becquerel (Bq) and equals 1 nuclear disintegration per second.

Types of Radioactivity at the Deloro Mine Site – There are two main types of low-level radioactive wastes at the Deloro site – tailings and slag. Radioactive tailings are found in the Industrial, Tailings, and Young's Creek (onsite) Areas. Radioactive slag is found in the Industrial and Main Mine Areas. A quantity of soil contaminated with low-level radioactive slag is also present at the site. This material was removed from the Village of Deloro as part of the Deloro Village Environmental Health Risk Study and will be included in the site cleanup.

Background Radioactivity Levels -- Typical background radiation fields in Ontario are between 0.03 microsieverts per hour (µSv/h) and 0.06 µSv/h.

Gamma radiation fields at the Deloro Mine Site vary from background levels to as high as 15 µSv/h measured at one metre above ground surface.

Measurements of exterior radon gas at the Deloro Mine Site show concentrations are within the range of natural background levels in the Great Lakes region of Ontario.

The average background concentrations of uranium in surface water and groundwater are 0.1 µg/L and 13.5 µg/L, respectively. The concentrations detected onsite were within the range of these natural background levels in Ontario. The concentrations detected were also less than the Health Canada Guidelines for Canadian Drinking Water Quality and the Ontario Drinking Water Standards (ODWS) Maximum Acceptable Concentration (MAC) of 0.6 Becquerels per litre (Bq/L) for Ra-226 and 0.1 mg/L for uranium.

For more information on radioactivity issues see *Deloro Mine Site Cleanup – Project Description, November 2002.*

Management of Low-Level Radioactive Materials

All low-level radioactive materials at the site will be excavated and/or covered in the Industrial Area and other areas of the site to reduce the radiation fields to background levels of 0.03 to 0.06 μSv/h

Evaluation of Alternatives

This section continues the review in the development of the draft cleanup plan, and includes a description of the rigorous process used to develop and screen cleanup alternatives for each area of the mine site.

As discussed above, the Deloro Mine Site Cleanup Project is being conducted according to the *Guidelines for Use at Contaminated Sites (MOE, 1997)* following the Site Specific Risk Assessment (SSRA) option. The approach has been adapted or enhanced to meet other regulatory or best management practices including the *Canadian Environmental Assessment Act* (CEAA).

Alternatives Selection

Cleanup strategies for the Deloro Mine Site Cleanup Project were selected using a very detailed and rigorous review process. A thorough review of scientific literature was used to develop a long list of possible conceptual cleanup methods for each area of the site. A four step process was used to develop and review cleanup alternatives. To be considered further each potential method had to meet all project cleanup objectives. Experimental methods were not considered.

Cleanup methods were evaluated using 16 different measures of effectiveness that considered technical, social, environmental, and cost considerations. All evaluation criteria carried equal weight in the process.

For each area of the site, each comprehensive cleanup alternative was compared to others. For the Industrial Area, 16 cleanup alternatives were considered, for the Mine Area three, for the Tailings Area six, and for the Young's Creek Area four.

<u>The Four Step Evaluation</u>

Step 1 - Meeting cleanup objectives

To be considered, each potential method had to meet the overall, site-specific and area-specific cleanup objectives for the Deloro Mine Site Cleanup Project. Experimental methods were not considered.

Step 2 – First screening evaluation

Conceptual cleanup methods were evaluated in a screening process to determine:

- **Effectiveness** -- Can the cleanup method reduce unacceptable impacts to people and the environment?

- **Satisfaction of government regulations and guidelines** -- Can the cleanup method meet relevant government legislation and guidelines?

- **Pre-established design closure criteria** – Is the cleanup method likely to satisfy the design criteria specific to each area of the site?

Cleanup methods that could meet all three criteria were then advanced to be considered as part of a **comprehensive cleanup alternative,** one that combined primary cleanup methods (those that would best address contamination issues) with enhancing features (those that would supplement cleanup methods and provide additional layers of safety).

Step 3 – Second screening evaluation

Evaluation of Comprehensive Cleanup Alternatives

Comprehensive cleanup alternatives were evaluated in a screening process similar to Step 2.

Step 4 – Detailed Evaluation Criteria

Comprehensive cleanup alternatives that could meet all three criteria were then advanced to another screening process using a number of detailed evaluation criteria.

For each area of the site, each comprehensive cleanup alternative was compared to others using the detailed evaluation criteria listed below. **All criteria carried equal weight in the evaluation process**.

Technical Considerations
- Reliability
- Compatibility with existing system
- Ease of implementation

Costs
- Operation and maintenance costs
- Capital costs

Social Considerations
- Public acceptance
- Risk to public
- Constraint for recreational use
- Negative impact to private properties
- Visual character of the area
- Risk to workers

Natural Environment
- Geochemistry
- Terrestrial habitats
- Floodplain
- Fish habitats

A cleanup strategy for each area of the site was recommended at the end of the evaluation process. That recommendation was further developed in a Closure Plan for each area of the mine site. Each recommended alternative satisfied the greatest number of criteria.

The Draft Proposed Cleanup Plan – Overview by Area

The following section outlines in general terms, the draft cleanup strategy for each area of the mine site. For more detailed information, please refer to the *Deloro Mine Site Cleanup-Integrated Cleanup Plan, Draft Report on the ministry's Web site, www.ene.gov.on.ca.*

Deloro Mine Site Draft Cleanup Plan -- Industrial Area

Concentrated industrial activity took place in this area from about 1867 to 1961. Activities included smelting, refining, and manufacturing of materials including arsenical-based pesticides, refined gold, refined silver, cobalt metal, stellite, and machine parts. This is the most heavily contaminated part of the site. Most of the ongoing arsenic loading to the Moira River comes from this area, and the Mine Area.

Area: 25 ha

Contaminants of Concern: Calcium arsenate/ arsenite and, slag and gold mine tailings contaminated with arsenic, cobalt, copper, lead, mercury, nickel, ferric arsenate (sludge from the Arsenic Treatment Plant), and low-level radioactive materials.

Volume of Wastes: Approximately 305,000 m^3

CLEANUP STRATEGY FOR THE INDUSTRIAL AREA

Consolidate and cover wastes with an engineered cover combined with groundwater and surface water flow diversion to enhance the existing collection/treatment system.

Overview

Consolidation of waste and capping

The most highly contaminated wastes will be placed in a waste consolidation area and capped with an engineered cover that is 1.5 metres thick. This will reduce the footprint (the total area) of the wastes, and will isolate them from the environment.

The soil along the western bank of the Moira River, once the site of the arsenic baghouse, will be removed and placed under the engineered cap. The riverbank will be reconstructed with "clean" fill.

Less contaminated materials will be covered with an engineered clay cap 1.5 metres thick to isolate them from people and the environment.

Ground and surface water diversion

Groundwater and surface water flow will be diverted away from contaminated materials. Clean groundwater will be diverted away from the wastes and under the engineered cover by a passive groundwater interceptor well network to be located near the western boundary of the Industrial Area. Extensive grading and interceptor ditches will be built to drain or divert surface water from the engineered cover.

The existing groundwater collection/treatment system (the Arsenic Treatment Plant) will continue to operate.

Demolition of unsafe structures

Unsafe structures and tanks will be demolished and consolidated with existing ruins.

Design Description

Site Preparation

To prepare the Industrial Area for construction, a number of actions will take place including:

- Establishing controls such as security fencing, signage, and air monitoring equipment, to protect the environment and human health,
- Mobilizing equipment (excavators, trucks, site trailers, and other equipment),
- Building access roads,
- Clearing land (trees may be mulched and reused on the site as cover)
- Establishing temporary services such as site trailers, utilities, and a decontamination pad.

Consolidation of Selected Wastes

The objective of waste consolidation is to reduce the footprint of the most highly contaminated wastes and to eliminate contact with ground and surface water.

The Industrial Area contains about 460,000 cubic metres (m^3) of uncontaminated and contaminated soil. The most highly contaminated material (highly leachable waste), has been defined, by the ministry's consultant, as waste with arsenic concentrations exceeding 4,000 parts per million (ppm).

Less contaminated material (marginally leachable waste) has been defined as waste with arsenic concentrations less than 4,000 ppm. Highly contaminated material in the Industrial Area will be consolidated under an engineered cover.

Less contaminated material will be covered with an engineered clay (simple earth) cap, along with low-level radioactive slag.

The Industrial Area contains approximately 262,000 m^3 of highly contaminated waste, approximately 4,000 m^3 of demolition/ruin rubble, approximately 39,500 m^3 of slag, and 900 m^3 of slag and soil removed from the Village of Deloro with slightly elevated levels of low-level radioactivity.[1] In addition, approximately 32,500 m^3 of highly contaminated waste and low-level radioactive slag will be transported from the Mine Area for consolidation under the engineered cover in the Industrial Area.

If demolition/ruin rubble is not contaminated, it may be used as cover material along the riverbank. The radioactive and non-radioactive slag will be used as backfill in the deeper excavated areas to the north and south of the proposed waste consolidation area.

The reuse of slag as backfill reduces the cost of importing "clean" fill to the site for excavated areas and the cost of placing an engineered clay cap over the slag to prevent exposure to low-level radiation or dust. The radioactive and non-radioactive slag occupies an area of approximately 17,000 m^2 and ranges from 1.0 to 3.1 m in average thickness.

All low-level radioactive materials will be excavated and/or covered in the Industrial Area and other areas of the site so that radiation fields will be reduced to background levels of 0.03 to 0.06 µSv/h.

Through the excavation and consolidation of about 131,000 m^3 of highly contaminated waste from the riverbank and north and south sections of the Industrial Area, the footprint of highly contaminated waste will be reduced from about 236,700 m^2 to about 60,000 m^2.

Riverbank Excavation and Reconstruction

About 620 m of contaminated materials along the west bank of the Moira River, adjacent the Industrial Area, will be excavated and the river bank will be reconstructed. This section of the west bank includes the area where the arsenic baghouse operated.

About 10,800 m^3 of waste soil will be excavated from this area. Contaminated material will be removed using techniques to prevent sediment from suspending in the water and being carried downstream. Contaminated material from the riverbank will be consolidated with other material under the engineered cap.

During reconstruction of the riverbank, the configuration of the river will be maintained as closely as possible to existing conditions of bank height, slope, and floodplain.

A more detailed description of this component is found in the report, *Deloro Mine Rehabilitation Project - Riverbank Reconstruction Alternatives for the Industrial Area, March 2002.*

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[1] The low-level radioactive slag transferred from the Village of Deloro is mixed in a matrix of soil contaminated with arsenic and will be placed under the engineered cover, unless the soil is found not to be highly contaminated.

River Diversion -- During the construction period, the Deloro dam or other flow diversion measures will be used to reduce flow in the river to a level that will expose all materials to be removed from the riverbank.

Streambed Protection, Erosion, and Sediment Controls – Every effort will be made to minimize the impact of construction on the existing streambed. No heavy equipment will work in or use the streambed for access during construction. Sediment and erosion protection procedures will be put in place during all phases of cleanup construction to ensure adequate protection of the stream habitat.

Measures will be implemented to prevent sediment from entering the stream or being deposited in the streambed during the removal of materials. Erosion protection will be used at the construction site to prevent runoff of sediment during the construction activities. Erosion protection will consist of silt curtains and straw bale dams. Details of the onsite erosion protection plan will be documented in the contract specifications prior to construction.

Engineered Cover

An engineered cover will be placed over the highly contaminated wastes to:

- Prevent precipitation from filtering through and coming in contact with highly contaminated waste and the underlying groundwater
- Prevent exposure of highly contaminated waste to people and the environment
- Eliminate contact with surface water

Construction of Engineered Cover -- The engineered cover will be placed over an area of approximately 60,000 m^2. Details of the construction of the engineered cover are provided below.

Hybrid Poplar Tree Cover

A hybrid poplar tree cover will be one component of the engineered cover, and is one of the technologies the ministry will use to prevent precipitation from filtering through contaminated wastes. A hybrid poplar tree cover will be placed on top of the engineered cover to manage water and reduce and/or stop precipitation. The cover design will include moisture retention layers to hold excess moisture until it can be taken up by the tree roots in the summer growing season.

The treed cover concept takes advantage of the tremendous potential water uptake capability of tree species such as the locally common poplar and red maple. When planted at an average density of one tree per 3 m^2, poplars at the Deloro Mine Site have the potential to draw up to 633.8 mm of water in a growing season from April to November. Average annual precipitation in the Deloro area is approximately 900 millimeters (mm); so theoretically, a treed cover has the potential to draw up most of the moisture.

For more detailed information on the hybrid tree cover, please refer to *Deloro Mine Site Rehabilitation Project – Feasibility Study for a Combined Soil Cover and Poplar Tree Cap in the Tailings Area, May 2002.*

ENGINEERED COVER DESIGN

Soil Layer	Depth Centimeters (cm)	Rationale
Upper Soil Profile	*Primarily intended to support the poplar trees and provide water storage capacity*	
Silty Loam Topsoil	15	Provides the initial rooting medium and the nutrients, organic material, and trace metals necessary for initial plant growth
Silty Clay Loam	35	Provides soil moisture storage capacity during the non-growing season and facilitates deeper rooting
Lower Soil Profile	*Further minimize percolation, permit drainage and provide additional storage capacity to increase the effectiveness of the cover during non-growing season*	
Compacted Clay	30	Acts as a restrictive barrier to minimize percolation of water into the underlying drainage layer
Sand	25	Acts as a water collection, storage, and transport system for water that penetrates the upper layers especially during the non-growing season. Collected water is diverted away from the Industrial Area
Manufactured (geosynthetic) Clay Liner	NA	Forms a secondary infiltration barrier of the engineered cover
Compacted Clay	50	Acts as a secondary restrictive barrier layer to minimize percolation of water into the underlying waste

Site Revegetation

Once completed, the engineered cover will be vegetated with grass. The grass cover is intended for short-term erosion control until the poplar tree cover is well established. Grass will eventually be shaded out as the canopy of the trees develops. With maturity, the thick root system of the trees will hold the soil together and the canopy of leaves will shield the ground from rain and erosion. When the leaves fall in the autumn, they will contribute to the mulch at the site and the overall capacity of the system to hold water. With time, the cover will become a mature forest with little wind or water erosion.

Engineered Clay Cap

An engineered clay cap (known as a simple earth cap) will be placed over the less contaminated (marginally leachable) soil that will remain following the excavation and consolidation of the highly contaminated material. The design objectives for the engineered clay cap are to:

- Prevent precipitation from filtering through and coming in contact with highly contaminated waste and the underlying groundwater
- Prevent exposure to people and the environment
- Eliminate contact with surface water

Engineered Clay Cap Design

The basic design of the 150 cm engineered clay (simple earth) cap is:

- 15 cm of topsoil
- 50 cm of compacted clay or other low permeability material
- 85 cm of "clean" or non-leachable, non-bioavailable (e.g. slag) backfill

With a thickness of 1.5 m, this design will minimize the risk of mammals burrowing into the underlying contaminated soils. This is a requirement of the Screening Level Ecological Risk Assessment, completed for the site.

For more details on the proposed design of the engineered clay cap, please refer to the draft Integrated Cleanup Plan section 2.1.

Ground and surface water diversion

Installation of Groundwater Interceptor Well Network

Groundwater in the area of the Deloro Mine Site flows naturally from west to east, from the direction of the Village of Deloro through the mine site, and discharges to the Moira River. Currently, as groundwater flows through the site it picks up the contamination deep in the soil, and carries it to the river. The groundwater collection system already in place, intercepts much of this contaminated groundwater and pumps it to the Arsenic Treatment Plant for removal of arsenic and other metals.

The proposed cleanup strategy for the Industrial Area involves diverting groundwater before it gets to the mine site. In order to achieve that, a passive groundwater interceptor well network (GIWN) will be constructed.

The GIWN will include a 900 metre (m) horizontal well placed several metres into the bedrock on the west side of the Industrial Area. Eight vertical pressure relief wells will extend 30 m into the deeper bedrock. The vertical pressure relief wells will flow by artesian pressure and will connect to, or be in close proximity of, the horizontal well.

The GIWN will lower the water table under the wastes to below the bedrock surface and divert clean groundwater from the wastes. The clean groundwater will be discharged to the Moira River.

Since it will take some time for the GIWN to lower the groundwater from beneath the waste area, the existing groundwater pumping stations will continue to operate until groundwater pumping and treatment are no longer required.

For more information on the GIWN see the *Industrial Area Closure Plan.*

Demolition of Buildings/Tanks and Resizing/Consolidation of Ruins

Most buildings at the site have already been demolished to some extent or are in various states of ruin. The remaining buildings are currently unused and pose potential safety hazards.

The ministry is considering preserving a few remaining structures as part of a heritage plan for the site. Those buildings include the powerhouse building, concrete trestle piers of the former primary treatment building, portions of the castings building walls, and the former powder house/magazine. The Arsenic Treatment Plant and the parking garage will be retained. With the exception of those structures the ministry is able to keep, all aboveground structures at the Deloro Mine Site will be demolished to ground level as part of the cleanup.

Uncontaminated demolition materials may be used for erosion protection as part of the reconstruction of the riverbank. Contaminated demolition materials will be consolidated and managed onsite.

Building materials, buildings in which low-level radioactive materials were handled will be tested for radioactivity before they are demolished. Those buildings or portions of buildings, found to contain low-level radioactive contamination will be moved into the waste consolidation area and capped with the engineered cover.

In addition to the buildings and infrastructure ruins, there is a large amount of rubble and waste spread in small piles around the Industrial Area. This material will be collected to improve the appearance of the site. All demolition materials will be reduced in size, where possible.

Uncontaminated wood waste will be reduced using a chipper, and used as a conditioner in the topsoil and engineered clay (simple earth) cap, or composted onsite. For more information on the demolition work required, including the locations of the buildings, tanks, and building ruins, see the *Industrial Area Closure Plan.*

Leachate Treatment

The ministry has implemented various strategies to reduce the arsenic loading to the Moira River since assuming control of the site in 1979. The Ontario Clean Water Agency (OCWA) operates the Arsenic Treatment Plant (ATP) and groundwater collection system on behalf of the ministry. Annual average withdrawal rates of approximately 100,000 m^3/year have had a significant positive impact on Moira River water quality. The arsenic loading to the Moira River has been reduced by more than 80 percent to an annual average of less than 10 kg/day, since the ATP was placed into operation in 1983.

The average annual arsenic concentrations in the Moira River decreased from 0.33 milligrams per litre (mg/L) in 1979 to an annual average of less than 0.08 mg/L since 1991 as measured at the Highway # 7/Moira River monitoring station.

The ATP will receive increased flows from collection and pumping of groundwater from the Mine Area (Tuttle Shaft), and leachate from the Tailings Area and the Young's Creek Area. However, groundwater diversion in the Industrial Area will gradually result in reduced flow rates from existing pumping stations and will ultimately result in a decrease in overall flow to the

ATP. Contaminant concentrations are expected to decrease with time as contaminated groundwater is removed from beneath the waste.

Key performance indicators for the Industrial Area

The draft cleanup strategy for the Industrial Area is expected to achieve the following:

- Capping of the entire Industrial Area will eliminate contact of surface water runoff with contaminated wastes/soils
- The engineered cover/hybrid poplar trees (over consolidated highly contaminated wastes) will allow only about four percent infiltration of annual precipitation
- The passive GIWN will:
  - Intercept approximately 960 m^3/day of clean groundwater before it passes through the site
  - Completely dewater wastes; this is necessary since current groundwater flow through the highly contaminated wastes in the Industrial Area is responsible for the majority of arsenic loading (approximately 80 percent) to the Moira River
  - Result in relatively low interference with the Deloro Village potable well (less than 2 m)
- Estimated reduction in arsenic loading to the Moira River, as a result of the waste consolidation, capping, and groundwater interception measures:

Arsenic loading to the Moira River	**Percentage reduction**
52.1 kg/day (1979)	
<10 kg/day (current -since 1983)	80 per cent reduction from 1979
Approximately less than 1 kg/day to achieve current/interim PWQO in the Moira River downstream of the site (once cleanup is complete).	98 per cent reduction from 1979 levels

Implementation of the cleanup strategy for the Industrial Area will provide safe, long-term containment of all Industrial Area wastes, including low-level radioactive materials.

Deloro Mine Site Draft Cleanup Plan -- Mine Area

Gold mining at the site took place over a period of about 35 years from about 1867 to 1902. Mine shafts were scattered throughout the site. The deepest mine shaft was the Gatling Shaft at a depth of approximately152 metres. The ministry located and sealed all major mine shafts, and remediated all other mine features from 1993-1995. The draft proposed cleanup strategy for the Mine Area deals with remaining waste rock and contaminated soils.

Area: Main Mine Area - 3 ha
Remote Mine Area - 114 ha

Contaminants of Concern: Arsenic, low-level radioactive slag

Volume of Wastes: Approximately 32,500 m^3

CLEANUP STRATEGY FOR THE MINE AREA

Relocation/consolidation of highly contaminated wastes to the Industrial Area, placement of a soil cover in the remaining areas and treatment of groundwater from the Tuttle Shaft.

Overview

Consolidation of wastes

Highly contaminated materials (including radioactive slag) will be excavated and relocated to the Industrial Area, where they will be consolidated under the engineered cover, 1.5 metres thick. "Clean" fill will replace the waste materials and the area will be vegetated.

Capping

Less contaminated areas will be covered with an engineered clay cap 1.5 metres thick.

Waste rock will be covered with a geofabric filter, clay, topsoil, (minimum total thickness 0.65 metres thick) and then vegetated.

Groundwater treatment

Groundwater will continue to be pumped from the Main Mine Area, and treated at the Arsenic Treatment Plant.

Design Description – Proposed Mine Area Cleanup

Site Preparation

Site preparation work will include:

- Mobilizing equipment (excavators, trucks, site trailers, and other equipment),
- Construction of temporary access roads, and establishing temporary services,
- Clearing vegetation and trees (to be kept to a minimum to preserve the natural condition of the site).

Excavate Highly Contaminated Waste and Impacted Soils

About 21,600 m^3 of highly contaminated waste/soil in the Main Mine Area will be excavated, consolidated with other highly contaminated wastes and placed under the engineered cover in the Industrial Area.

Excavated areas will be backfilled with "clean" fill material and compacted. The fill will be covered with a 0.15 m topsoil layer and vegetated. If the remaining soils are found to be contaminated to a lesser extent, or elevated risks to people and the environment are still present, an engineered clay cap (a simple earth cap) will be used to cover the excavated areas.

Selected soils in the Remote Mine Area will also be excavated and consolidated in the Industrial Area (approximately 7,800 m^3). Excavated areas will be backfilled with "clean" fill material.

In the alternatives report for the Mine Area, a cover thickness of 650 mm was selected to provide an infiltration barrier plus a suitable growing medium for plants. However, as a result of the draft Site Specific Risk Assessment, the capping thickness was increased to 1,350 mm for clay/fill materials and 150 mm for topsoil, totaling 1,500 mm. This will reduce the potential for exposure to contaminants by burrowing animals and root penetration.

The waste rock areas will be covered with a manufactured filter (geofabric), 500 mm of clay, and 150 mm of topsoil since the contaminants in these areas are not considered bio-available, and burrowing animals and tree roots are not expected to reach the underlying impacted materials.

About 5 m^3 or less of low-level radioactive slag (1 – 2 microsieverts per hour (μSv/h)) is in an area adjacent to the Tuttle Shaft. This material will be removed and consolidated with similar materials in the Industrial Area. The excavation will be filled in with "clean" fill material and then capped with an engineered clay cap.

Following completion of site cleanup (i.e. surface water control features, waste excavation and consolidation, cover/cap placement, site grading), the Main Mine Area and selected Remote Mine Areas will be landscaped and seeded with a mixture of grasses in order to stabilize the surface and limit erosion. The cover/cap will also be vegetated with trees and shrubs to increase the water uptake by plants.

Cover Waste Rock and Marginally Leachable Soil and Vegetate

Less contaminated soils in the Main Mine Area will be covered with layers of topsoil, fill, and compacted clay materials. The topsoil provides the initial rooting medium for the cover vegetation.

The fill material will be deep enough to prevent roots and burrowing animals from being exposed to the contaminated soils below. The compacted clay layer will minimize percolation of water into the materials below.

Accumulations of waste rock from historical mine activities have been identified in both the Main and Remote Mine Areas. Waste rock will be isolated from the surrounding environment.

The first step will be to regrade the waste rock with heavy machinery so that stormwater runoff is directed away from the covered waste rock. The regraded piles will be covered with a manufactured filter (geofabric) to simplify the installation of cover materials. Clay will then be used to cover the geofabric filter to a depth of 0.5 m to help prevent water from seeping through. Vegetation and trees will be planted in a 0.15 m topsoil layer, placed above the clay layer to blend with existing conditions adjacent to the affected area and graded to promote stormwater runoff. The total depth of the cover material will be a minimum of 0.65 m.

Upgrade Tuttle Shaft Pumping System

The Tuttle Shaft is a former mine shaft in the Main Mine Area. Groundwater collects in the shaft naturally, and eventually flows to the Moira River. The ministry capped the shaft in 1994. A pump system is used to direct contaminated groundwater to the equalization pond and Arsenic Treatment Plant.

The Tuttle Shaft currently flows by gravity under artesian conditions to the Moira River, for nine months of the year. At this time, the Tuttle Shaft pump is only operated during low-flow conditions in the Moira River, a period of two to five months during the summer and fall. As part of the cleanup proposed for the Mine Area, groundwater collected in the Tuttle Shaft will be pumped on a year-round basis and treated at the Arsenic Treatment Plant. This will eliminate the artesian discharge of arsenic-contaminated groundwater to the Moira River.

Key performance indicators for the Mine Area

The draft cleanup strategy for the Mine Area is expected to achieve the following:

- The highly contaminated wastes will be excavated and consolidated under the engineered cover, eliminating these sources in the Main Mine Area and the Remote Mine Areas
- The waste rock stockpiles and less contaminated wastes/soils will be capped, minimizing contact with ground and surface water
- Increasing pumping at the Tuttle Shaft to year-round pumping will eliminate the artesian discharge of arsenic contaminated groundwater to the Moira River
- The cleanup activities and year-round pumping at the Tuttle Shaft (together with the cleanup activities in the Industrial Area) are expected to substantially reduce arsenic loading to the Moira River (to approximately less than 1 kg/day)

Cleanup in the Mine Area will provide safe, long-term containment of the remaining wastes/soils in the Main Mine Area, and includes removal of a small quantity of low-level radioactive slag for consolidation with similar wastes in the Industrial Area.

Deloro Mine Site Draft Cleanup Plan -- Tailings Area

The Tailings Area, to the east of the Moira River, was once a natural lowland area. During the ore refining process, ferric hydroxide (red mud) was pumped as waste slurry from the hydrometallurgical plant that operated from 1914 to 1961. The Ministry of the Environment covered this area with a half a metre of crushed limestone in 1986/1987 to eliminate wind and surface water erosion, and to address chemistry related issues. The cover also acts as a shield against low-level radioactivity present in the tailings.

Area: 13 ha

Contaminants of Concern: Arsenic, cobalt, copper, nickel, and low-level radioactive material

Volume of Wastes: Approximately 45,000 m^3

CLEANUP STRATEGY FOR THE TAILINGS AREA

Cover tailings with an engineered soil cover combined with collection/treatment of groundwater and upstream surface water flow diversion.

Overview

Engineered cap

The existing limestone cap in this area will be covered with an engineered cap that is 1.75 metres thick, and vegetated with hybrid poplar trees and grass. These measures will prevent 90 percent of precipitation from infiltrating the tailings.

Ground and surface water management

An interceptor ditch will be built to divert clean, upstream surface water away from the engineered cover.

Water collection/treatment

Contaminated seepage will be pumped and collected for treatment at the Arsenic Treatment Plant.

Design Description

Site Preparation

Site preparation activities will include:

- Preparing access routes,
- Constructing a washpad and mobile washer,
- Installing surface water controls,
- Temporary road construction to the Tailings Area
- Clearing vegetation and trees on the Tailings Area surface and around the perimeter.

Rip Rap and Geotextile

Rock cover material (rip rap) and a manufactured filter (geotextile) will be placed at the toe of the east and west tailings dam walls to provide a seepage collection area. Geotextile will also be installed along the slope of the crushed limestone berm portion of the two dam walls and over the limestone cover of the Tailings Area.

Engineered Cap, and Poplar Tree Plantation

The existing limestone cap will be covered with an engineered cap 1.75 metres thick. The cap will consist of a layer of silty clay loam in combination with topsoil, sand, perforated collection pipe, and compacted clay materials. A geotextile filter will separate the cover soils from the crushed limestone.

The topsoil will provide the initial rooting medium for a hybrid poplar tree plantation, while the silty clay loam and sand will provide the necessary water storage capacity that will increase the effectiveness of the poplar trees. The compacted clay layer will minimize the movement of water into the underlying limestone cover and tailings.

An irrigation system will be installed and operated for a period of about three years while the hybrid poplar tree plantation matures.

Interceptor Ditch

In order to further reduce contact with surface water an interceptor ditch will be built along the north and east side of the Tailings Area. Clean surface water runoff (i.e. stormwater) will be diverted to Young's Creek by the interceptor ditch. Surface water runoff from the capped tailings will be diverted by ditches to low-lying areas south of the Tailings Area. Final surface grading of the Tailings Area will be designed to promote surface water runoff.

Collecting and Treating Contaminated Seepage

Seepage from both the east and west sides of the Tailings Area currently contributes much of the cobalt and copper coming from the site to the Moira River and Young's Creek. A collection and pumping well system will be installed to capture contaminated groundwater and seepage beneath the east and west tailings dams.

Contaminated water will be pumped from the wells to temporary storage tanks. The contaminated water will then be pumped to the equalization pond (i.e. equalization storage basin) for treatment at the Arsenic Treatment Plant (ATP).

The main contaminant of concern from this area is cobalt, although seepage also contains lower concentrations of copper and arsenic. Since the existing ATP can remove dissolved cobalt from contaminated groundwater, the increase in capital, operation, and maintenance costs associated with installing a collection and pumping system for the Tailings Area, is considered good value for the amount of cobalt that will be removed from the environment.

Contaminated seepage and groundwater from the Tailings Area will be pumped to the Arsenic Treatment Plant for four to seven years while the hybrid poplars reach maturity.

Pumping might be phased out in the future when water control measures take effect and reduce the amount of seepage. If the amount of seepage is reduced significantly, but still requires some treatment, a natural wetland treatment system can be installed to provide long-term water quality improvement.

Revegetation

Following completion of the cleanup, the Tailings Area will be landscaped and seeded with a mixture of grasses to stabilize the surface and limit erosion until the hybrid poplar tree plantation is firmly established.

Key performance indicators

The draft cleanup strategy for the Tailings Area is expected to achieve the following:

- The engineered cover and hybrid poplar trees will allow less than 10 percent of the annual precipitation to infiltrate to the underlying tailings, thereby minimizing contaminated seepage beneath the walls of the tailings dams.
- The interceptor ditch will divert clean surface water from upstream of the Tailings Area, further reducing contact with surface water.
- The cleanup measures will reduce the discharge of cobalt and copper from the Tailings Area to the Moira River.

Cleanup of the Tailings Area will provide safe, long-term containment of the tailings, including low-level radioactive materials.

Deloro Mine Site Draft Cleanup Plan -- Young's Creek Area

Young's Creek begins on the Deloro Mine Site at its northeast corner and flows south along the eastern side of the Tailings Area, connecting with the Moira River south of Highway #7.

Over the last century, run-off from the Tailings Area has resulted in heavy sediment contamination in the creek. Water flow is very low in this area, which is typically wetland-like in nature. Young's Creek currently contributes about three percent of the arsenic loading to the Moira River watershed.

Cleanup of this area is planned due to the high levels of metals in sediments, the presence of low-level radioactive material in the onsite portion, and due to the potential for occasional high river flows to re-suspend contamination, especially during a 100-year flood event. Biological diversity and abundance in this area are affected as a direct result of contaminated sediments.

The Young's Creek Area is part of a provincially significant wetland, known as the Deloro Wetland Complex. In light of that fact, a wetland restoration plan will be implemented following removal of contaminated sediments.

Area: Onsite – about 47 hectares (ha)
Offsite (south of Highway # 7) – about 19 ha

Contaminants of Concern:

Onsite area -- Arsenic, cobalt, copper, nickel, and low-level radioactive material

Offsite area -- Arsenic, cobalt, copper, and nickel. There is no radioactivity in the offsite area.

Volume of Wastes:

Onsite -- 100,000 cubic metres (m^3) of shallow contaminated sediments and about the same amount of contaminated deeper soils

Offsite -- About 68,000 m^3 of contaminated shallow sediments

CLEANUP STRATEGY FOR THE YOUNG'S CREEK AREA

Full depth excavation of onsite sediment, shallow depth excavation of offsite sediment, and disposal in a new onsite engineered containment cell followed by creek rehabilitation.

Overview

The Young's Creek Area includes an onsite and an offsite portion. The onsite portion is much more contaminated, and to a greater depth than the offsite portion.

Excavation and containment

Contaminated sediments and soils will be excavated, dewatered, and placed in a secure engineered containment cell that will be built onsite to the south of the Tailings Area.

The containment cell will have an engineered vegetated cap and liner system to isolate contamination from the environment. The cell will be substantial in size, covering an area of about 5 hectares (ha) to a height of approximately 17 metres.

Wetland reconstruction

Areas of the wetland removed by excavation will be reconstructed. This is especially important for rebuilding the ecosystem since this area is part of a provincially significant wetland.

Design Description

Site Preparation

Site preparation work will include:

- Mobilization of equipment (excavators, trucks, dewatering pumps and equipment, site trailers),
- Construction of access roads, and establishing temporary services,
- Draining any ponded water to allow excavation work to be done in the "dry"
- Sediment control measures will be implemented to minimize the transport of disturbed sediment from Young's Creek to the Moira River.

Excavation and Containment

Construction of Staging Areas

Before excavating contaminated sediment/soil, temporary storage areas (known as staging areas) will be constructed. To build the staging areas, a manufactured filter (geotextile) will be placed on the ground. It will be covered with 300 mm of crushed rock. Another manufactured filter (geotextile) will be placed on top, and 150 mm of gravel (granular A) added to that.

Two separate staging areas will be required, one for the onsite portion and one for the offsite portion of Young's Creek. The staging areas will provide a stable work platform where wet contaminated sediment/soil can be dewatered prior to placement in the secure containment cell. Clay diversion dams will be built to isolate the staging areas from potential flood waters.

Dewatering Excavated Materials

Contaminated sediment and soil will be dewatered before being placed in the onsite containment cell. Dewatering will occur in the onsite and offsite staging areas. Excavated contaminated sediment and soil will be dewatered by placing the wet material in rows, approximately 1.5 m in height and 4 m in width. Rows will be placed parallel, and will be spaced approximately 4 m apart to allow an excavator to travel between them. The excavator will move between the rows and turn over the wet sediment/soil to promote dewatering and drying. Rows will, in sequence, be moved closer to the stockpile location.

After five turnover/movements, the sediment and soil should be dry enough to place into the dewatered material stockpile. Bulldozers will be used to create a ramped stockpile that will be about 5 m in height. The material stockpiles will eventually be loaded onto trucks for storage in the secure onsite containment cell.

The onsite and offsite staging areas will have an approximate area of 12,000 m^2. The onsite and offsite staging areas will allow sediment/soil to be dewatered at a rate of approximately 1,000 m^3/day. These dewatering rates result in approximately 200 excavation days and 70 excavation days respectively, required for the onsite and offsite portions of Young's Creek.

Silt Curtains and Sedimentation Basins

Silt control fencing will be placed along the perimeter of each staging area to prevent the movement of sediment/soil to the Young's Creek Basin.

As backup to the silt control fencing, two sedimentation settling basins will be created in the onsite and offsite portions of Young's Creek. The sedimentation basins will allow suspended sediment to settle out, and will prevent them from going into the river. The sedimentation basin for the onsite portion of Young's Creek will be created north of Highway # 7.

For the offsite portion of Young's Creek, a sedimentation basin will be created in the southern portion of the Southern Pond. Suspended sediment that accumulates in the sedimentation basins will be removed and placed in the secure onsite containment cell.

For the small portion of the creek between Old Marmora Road and the Moira River, sedimentation controls such as manufactured filter (geotextile) silt fencing, sand bags, and/or straw bales will be used. This portion of the creek will be excavated during a low-flow period to minimize the movement of suspended sediment to the Moira River.

Temporary Diversion Dams

Once the staging areas and sedimentation basins are in place, temporary diversion dams and ditches will be used to isolate sections of the Young's Creek Basin. The temporary diversion dams will allow flow through the Young's Creek Basin at all times during the work. Excavation activities will proceed in the downstream direction to prevent recontamination of remediated areas. The diversion dams will divert surface water flows around the active excavation area and will allow excavation work to proceed in the "dry".

The diversion dams will have a base width of approximately 8 m, a top width of 1 m, and a height of 2 m above the existing creek bed. The elevation of the top of the diversion dam will be

approximately 0.5 m higher than the flood water level to control flooding. The dams will be constructed with a clay core and covered with a layer of cover material (rip rap) to prevent erosion.

After the diversion dams are in place, water will be pumped out into the adjacent portions of the creek. After the water has been removed, contaminated sediment will be excavated, loaded, and transported to the staging areas using six-wheel drive articulating dump trucks. The use of these six-wheel drive vehicles will allow transport of contaminated sediment/soil from the excavation site directly to the staging areas without having to leave the Young's Creek Basin.

Crushed granular rock will be placed within portions of the dewatered ponds of the Young's Creek Basin, to create a temporary haul road from each excavation site to the staging area. This crushed granular rock will be removed and reused following the completion of a given sector.

Following dewatering the sediment/soil will be loaded and transported to the secure onsite containment cell.

Once excavation activities are completed, the gravel (granular A) used to construct the staging area will be removed and disposed in the secure onsite containment cell. The crushed stone underlying the gravel will be removed and stockpiled for future onsite re-use. Contaminated sediment/soil underlying the staging pads will be excavated and transported directly to the secure onsite containment cell. Dewatering of the sediment/soil will occur in the containment cell. The leachate from this dewatering will be collected by the leachate collection system.

Dewatered sediment/soil will be loaded onto trucks and transported to the onsite containment cell. For the onsite portion of the excavation work, trucks will use the existing access road that runs parallel to the onsite portion of Young's Creek. No offsite transport of contaminated sediment will be required for the onsite portion of Young's Creek. Temporary access roads are not required in the onsite portion of Young's Creek.

Temporary Access Roads

For excavation work in the offsite portion of Young's Creek, temporary access roads will be built between the ponds to allow movement of contaminated sediment from the Central and Southern Ponds to the staging area in the Northern Pond.

The access roads will be approximately 5 m in width. Material used to construct the temporary access roads include a non-woven geotextile placed on the sub-grade, 300 mm of compacted gravel (granular B), followed by 150 mm of compacted gravel (granular A). Crushed granular rock will be used to create temporary haul roads within portions of the dewatered ponds.

Following dewatering and stockpiling in the staging area, the contaminated sediment will be transported to the onsite containment cell. The transport trucks will be required to cross Highway # 7. The trucks will then use the access road that runs parallel and to the west of the onsite portion of Young's Creek to access the onsite containment cell.

Containment Cell Liner System Construction

Excavated sediment/soil will be placed in an engineered secure onsite containment cell to be built south of the Tailings Area. The proposed containment cell will be located about 200 m

south of the existing Tailings Area and approximately 600 m north of Highway # 7. The footprint of the cell covers approximately 5 ha and will rise approximately 17 m above the existing Young's Creek bed. The containment cell will provide a capacity of approximately 270,000 m^3 for contaminated sediments.

The containment cell will have an engineered cap and liner systems that will be designed to prevent contaminant releases. The cap will consist of a vegetated cover, 150 mm of topsoil, 1,000 mm of compacted fill, over a geotextile, a 300-mm cap drainage layer of crushed granular material, and a manufactured (geosynthetic) clay liner within a 500-mm sand cushion and sand grading layer to prevent infiltration of surface water. The cap will be designed to promote runoff and water uptake by plants, thereby reducing the amount of precipitation that could come into contact with the contaminated sediment/soil in the containment cell.

The cap includes a drainage system to intercept any water that does not run off or is not absorbed by roots before it contacts the stored sediment/soil. This clean infiltrating water collected in the cap system will be directed to Young's Creek. The thickness of the cap will also reduce low-level radiation fields associated with some of the radioactive sediments to background.

The base liner system will consist of 1,000-mm thick composite clay and a thick plastic liner with a leachate collection system embedded in a 300-mm granular drainage layer to collect any water that does happen to penetrate the cap system. The liquid collected by the leachate collection system will be collected in sumps and stored in a holding tank that will be pumped and transported to the Arsenic Treatment Plant in the Industrial Area. The containment cell will be located above the water table to prevent groundwater contact with stored sediment/soil.

Creek Rehabilitation, Engineered Wetland

Following excavation of contaminated sediment and soil, the area will be graded to provide a wetland shelf around the perimeter of the ponded areas, to re-establish the wetland environment.

The shelf will be graded to provide a water depth (approximately 300 mm) to support a diverse wetland community associated with marsh habitat. The shelf will be continuous around the perimeter and have varying widths of plus or minus 3 m based on both aesthetic and Ministry of Natural Resources (MNR) requirements.

A 75-mm to 100-mm layer of topsoil will be placed on top of the wetland shelf to provide an ideal environment for seed germination and root development. The shelf will provide limited treatment potential, but will stabilize the soil and provide an aesthetic function. The perimeter shelf will create an ideal environment for the natural revegetation to occur.

A series of wetland planting cells will be built at locations throughout the wetland perimeter shelf. The wetland planting cell will be approximately 10-m by 10-m in area. The plant mix will consist of seed and potted plant stock. It will include native shrubs, sedges, rushes, and grasses. For every kilometre of creek bank, three planting cells will be built.

Two constructed wetland parcels will provide water quality improvements. One wetland parcel will be located onsite at the southern extent of the remediated area just upstream of Highway # 7. The offsite parcel will be located just upstream of the point of discharge into the Moira River.

The wetland parcels will provide some level of treatment and filtration prior to the discharge of creek water into the Southern Pond and the Moira River.

Key performance indicators

The draft cleanup strategy for the Young's Creek Area will achieve the following:

- Removal of the contaminated sediments/soils, including the low-level radioactive sediments that originated from the Tailings Area will address the following issues:
  - Exposure to radiation
  - Elevated human health and ecological risk
  - Potential erosion/transport of contaminated materials downstream during severe storm events/acts of nature
  - Undesirable risk to people and the environment in the offsite portion of Young's Creek

The secure containment cell will provide safe, long-term storage of these materials, including the radioactive tailings/sediments.

Deloro Mine Site Cleanup Project -- Next Steps

2004

Public Consultation on the Draft Proposed Cleanup Plan

The Ministry of the Environment is committed to public consultation on the draft cleanup plan. On June 15, 2004, the ministry initiated consultation with the two technical committees for the Deloro Mine Site Cleanup Project (the Technical Liaison Committee, and the MOE Technical Committee). On July 21, 2004, the ministry broadened that consultation to include the Public Liaison Committee. CH2MHILL's draft proposed cleanup plan was presented to the Deloro Mine Site Cleanup Project's three project liaison committees at a joint workshop on July 21, 2004. Members of these committees were given the first opportunity to review the cleanup plan and provide comments. Those comments have been considered and incorporated where possible.

The ministry invites residents of Deloro, residents downstream of the site, local municipalities, environmental groups, and anyone with an interest in the project to review the draft cleanup plan for the Deloro Mine Site. Comments will be recorded, and reviewed. A summary of comments and responses to those comments will be provided as a record of consultation. Once consultation is complete, the ministry and its consultants will finalize the cleanup plan. The 60-day comment period will close on January 12, 2005.

For more detailed technical background information a CD, containing the full technical report of the draft cleanup plan, the rehabilitation alternatives and closure plans for each area of the mine site, is available for reference.

How to Access Reports

The technical reports used in the development of the draft cleanup plan, are available for viewing at ministry offices in Kingston, Belleville and Peterborough; the Deloro Village Library; the Municipality of Marmora and Lake; the Municipality of Centre Hastings; Quinte Conservation;

the ministry's Environmental Assessment and Approvals Branch (Approvals, Public Record File and Environmental Clean-up Fund), Toronto; the Ontario Clean Water Agency, Deloro; the Ministry of Northern Development and Mines, Sudbury; and the Ontario Legislative Library, Toronto. The Alternatives Reports, Closure Plans for each of the four areas of the mine site, and the full technical draft Integrated Cleanup Plan are available for downloading from the ministry's Web site at http://www.ene.gov.on.ca/envision/deloro/index.htm.

Public Information Session – November 23, 2004

To further explain the details of the cleanup plan, a public information session will be offered at the Deloro Community Centre on November 23, 2004. There will be two sessions, one from 1 – 5 pm, and an evening session from 7 pm – 10 pm.

Optional Workshop – November 29, 2004

For those who would like an additional opportunity to discuss and provide feedback on the draft cleanup plan, the ministry will offer a registered workshop on November 29, 2004 at the Deloro Community Centre. The workshop will only be held if there is sufficient community interest. If you are interested in participating in this workshop, please register in advance by calling Heather Hawthorne, Communications Advisor, 613-549-4000 extension 6927.

Please provide your comments in writing no later than January 12, 2005 to:

Deloro Mine Site Cleanup Project
Ministry of the Environment
133 Dalton Avenue
Kingston, Ontario
K7L 4X6

2005

Finalize the cleanup plan: The ministry will finalize the cleanup plan following public consultation.

Detailed engineering design: Development of the 'blueprints' for engineered facilities, covers, caps, wells and pumping stations.

Licence applications and permits: Regulatory approvals that must be obtained in order to proceed with construction, including permits from: the Ministry of the Environment (MOE), Conservation Authority (CA), Ministry of Natural Resources (MNR), Department of Fisheries and Oceans (DFO), Canadian Nuclear Safety Commission (CNSC), and the Ministry of Northern Development and Mines (MNDM) among others.

Federal Environmental Assessment Requirements: Required as part of the ministry's application to the Canadian Nuclear Safety Commission (CNSC) for a licence for the long-term storage of the existing low-level radioactive material at the site.

2006

Tendering: Offering construction contracts for cleanup work through a competitive bid process.

Site preparation construction: Preparation of the site for major cleanup construction activities will involve construction of access roads and wash-down facilities, clearing vegetation and trees, and installation of surface water controls.

2007 - 2012

Complete the cleanup: Major cleanup construction begins. All materials will be secured to make the site safe for people and the environment for hundreds of years.

Long-Term Commitment

The Ministry of the Environment will maintain its long-term commitment to this site. The site will require ongoing monitoring of surface water, groundwater, pumping systems, and the wastewater treatment plant to ensure the continued effectiveness of the site cleanup measures.

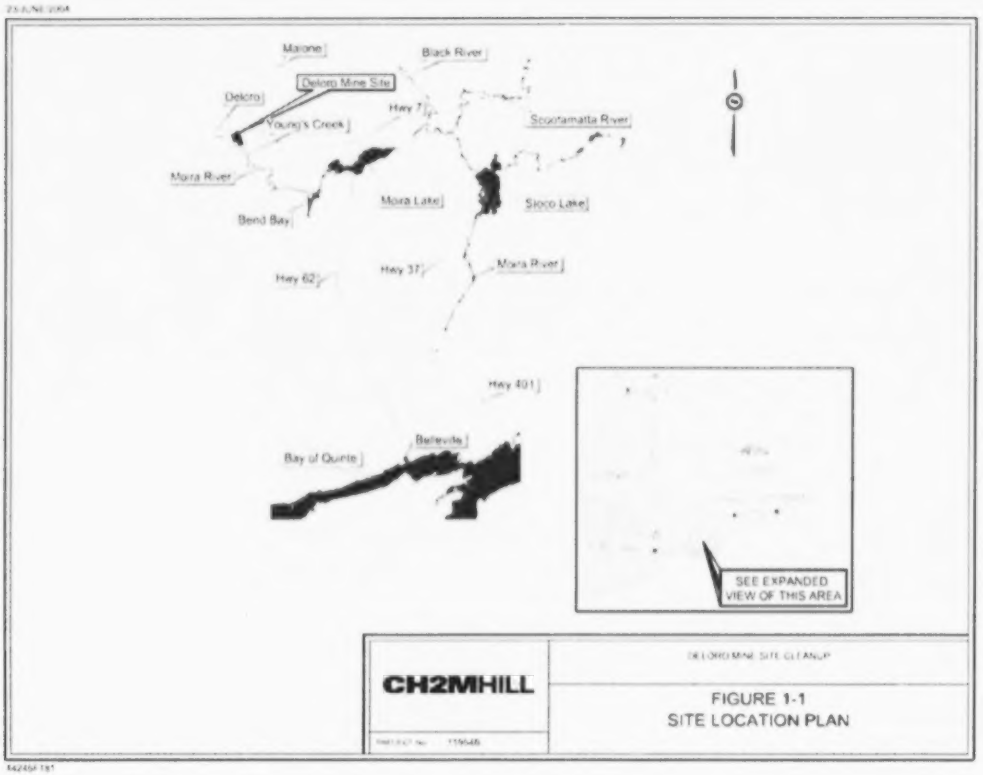
Estimated Cost of Site Cleanup

The total estimated capital cost to complete the cleanup is $30 – 40 million with annual operation, maintenance, and monitoring costs of approximately $1,124,000.

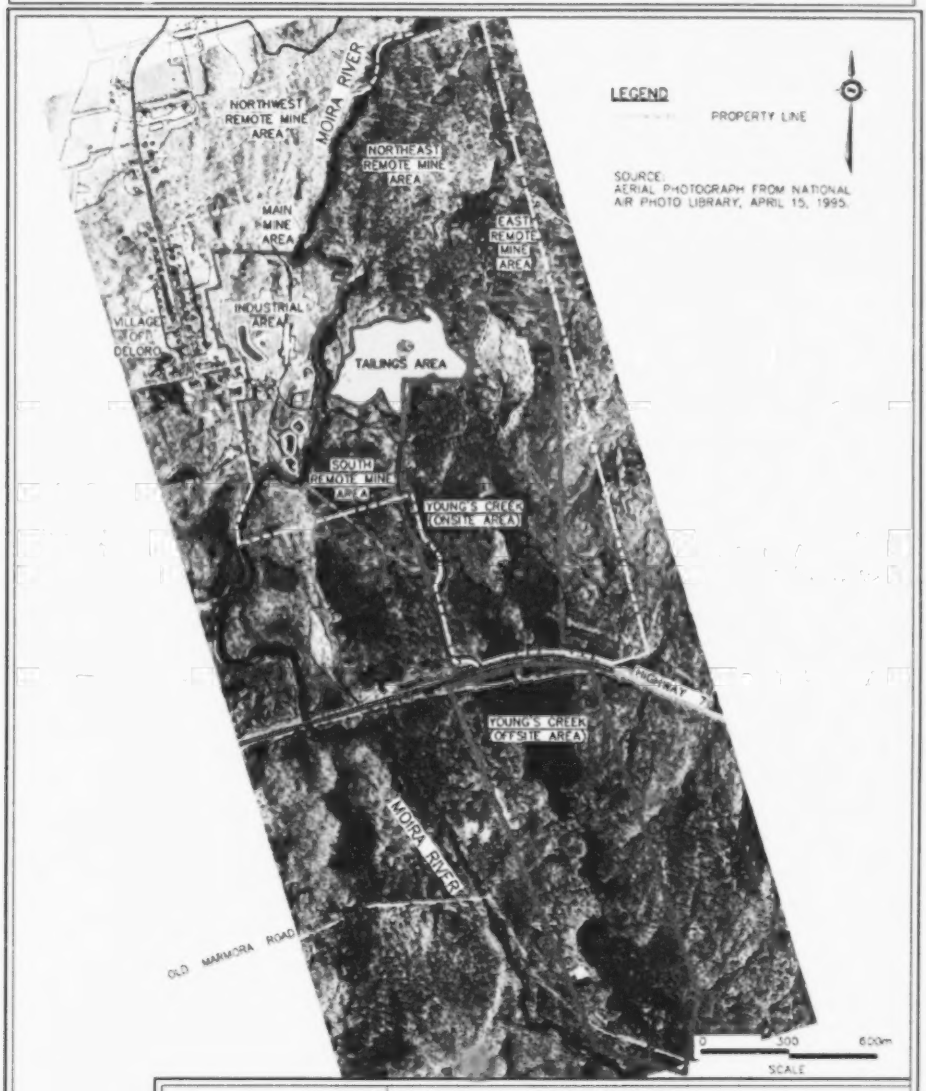
This cost estimate will be further refined once the draft cleanup plan has been finalized and the detailed design work completed.

Long-term funding for the project will continue to be made available through the ministry's Environmental Cleanup Fund. The Province of Ontario is committed to this project, and will finish the cleanup to ensure the site is safe for people and the environment for hundreds of years.

Appendix A – Illustrations



Deloro Mine Site – Division of Areas



CH2MHILL

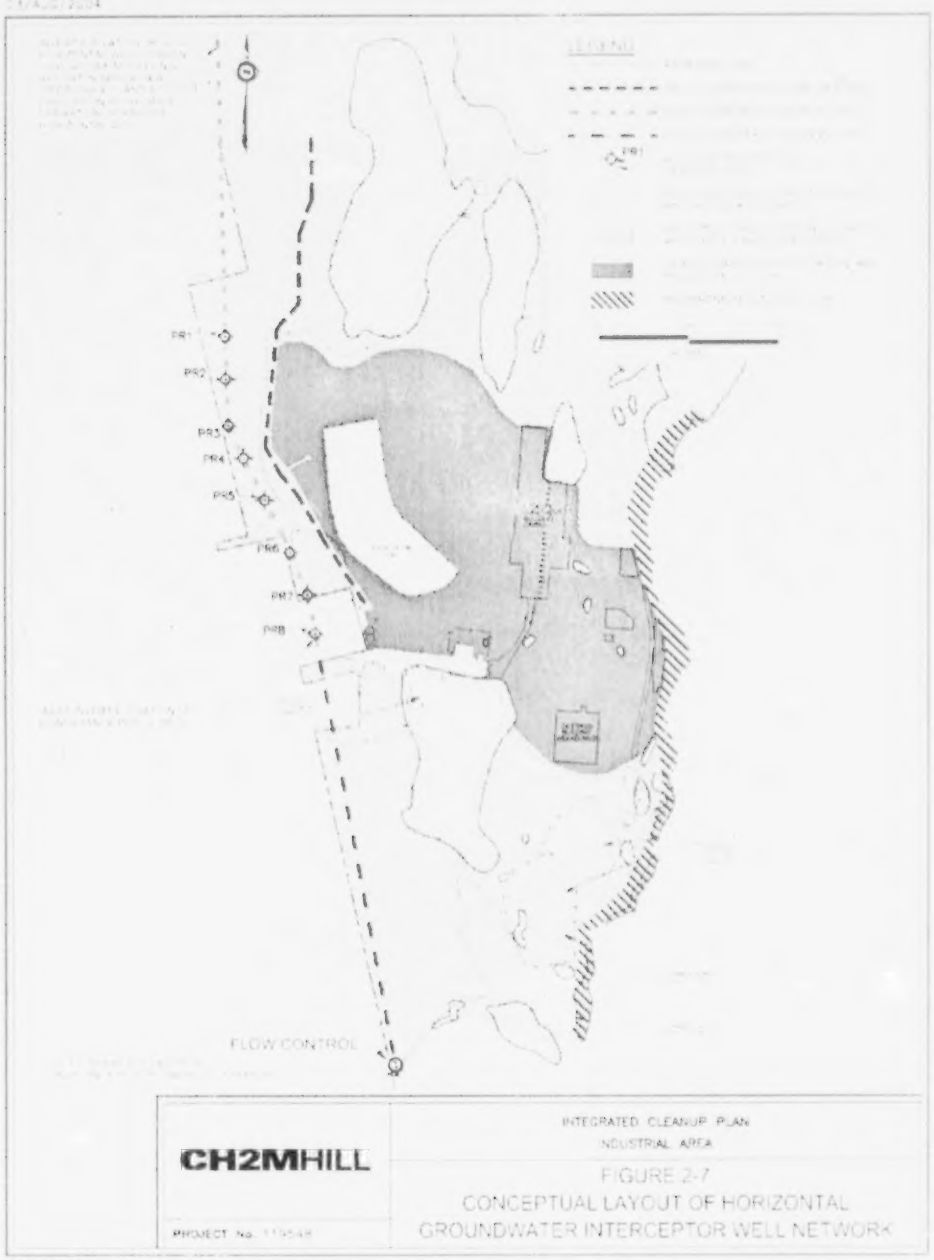
DELORO MINE SITE CLEANUP

FIGURE 1-3: DELORO MINE/REFINERY SITE SHOWING THE INDUSTRIAL, MINE, TAILINGS AND YOUNG'S CREEK AREAS - DELORO, ONTARIO

PROJECT No. 119548

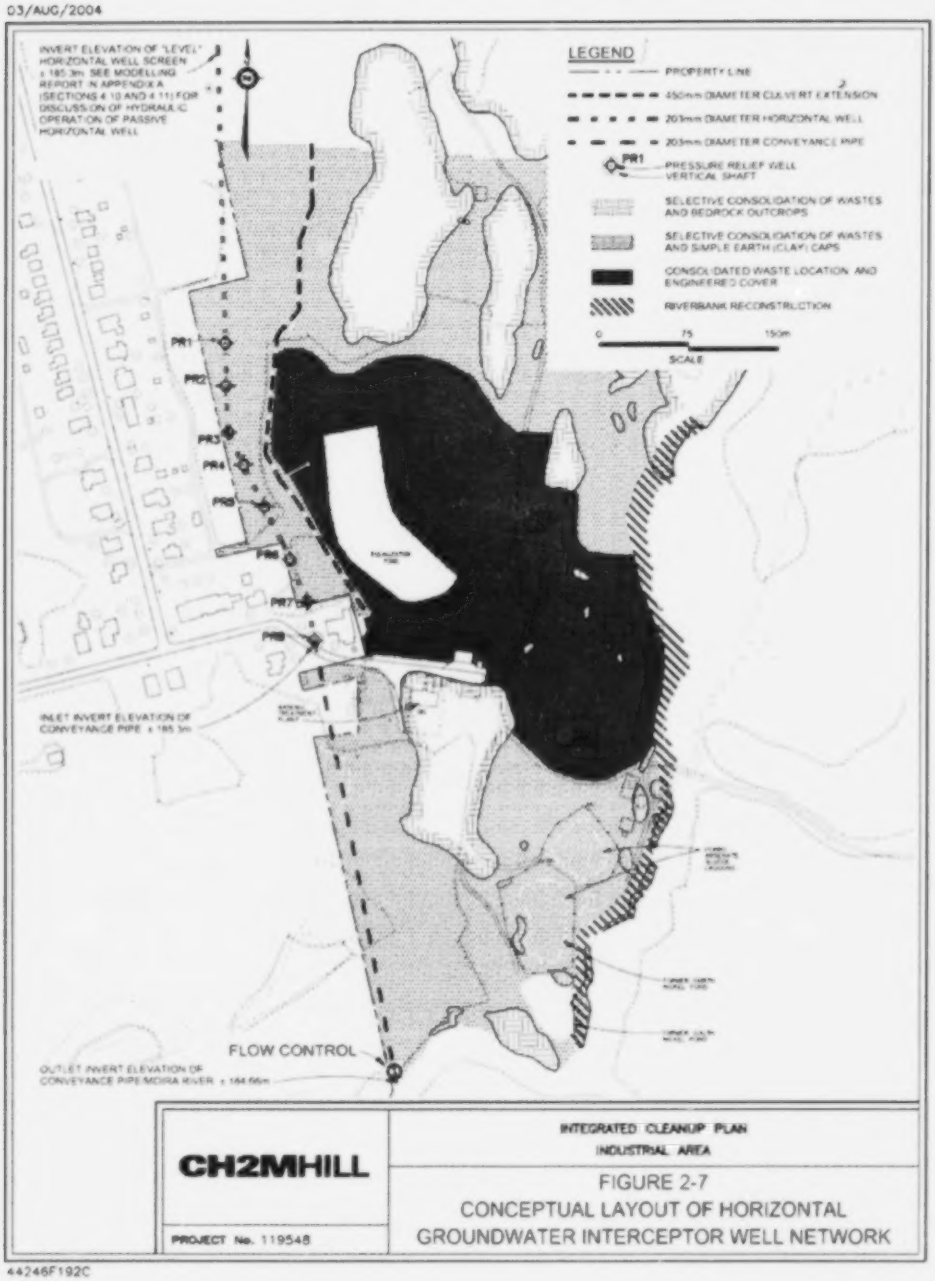
44246F99E

Overview, Industrial Area



Overview, Industrial Area

03/AUG/2004



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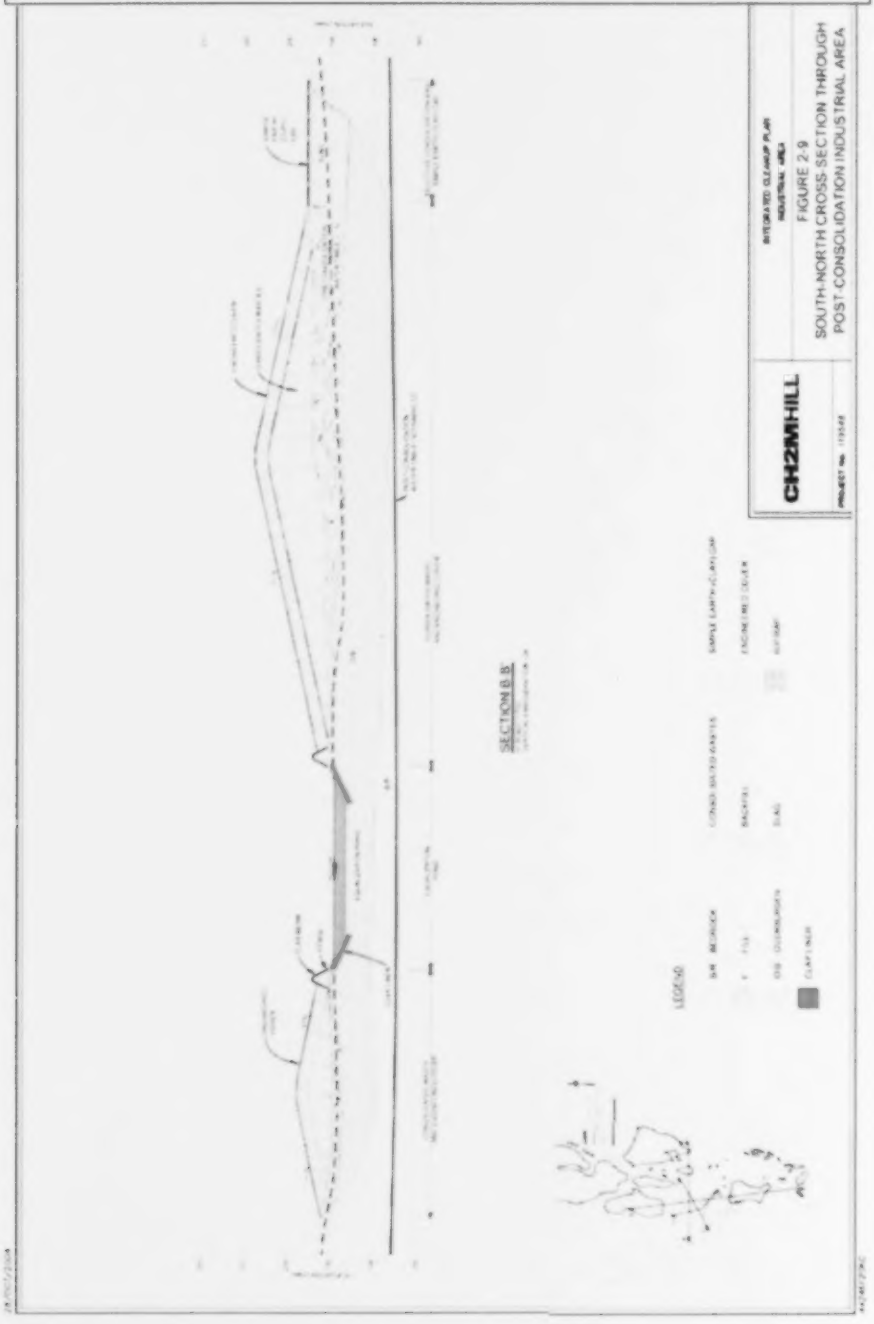
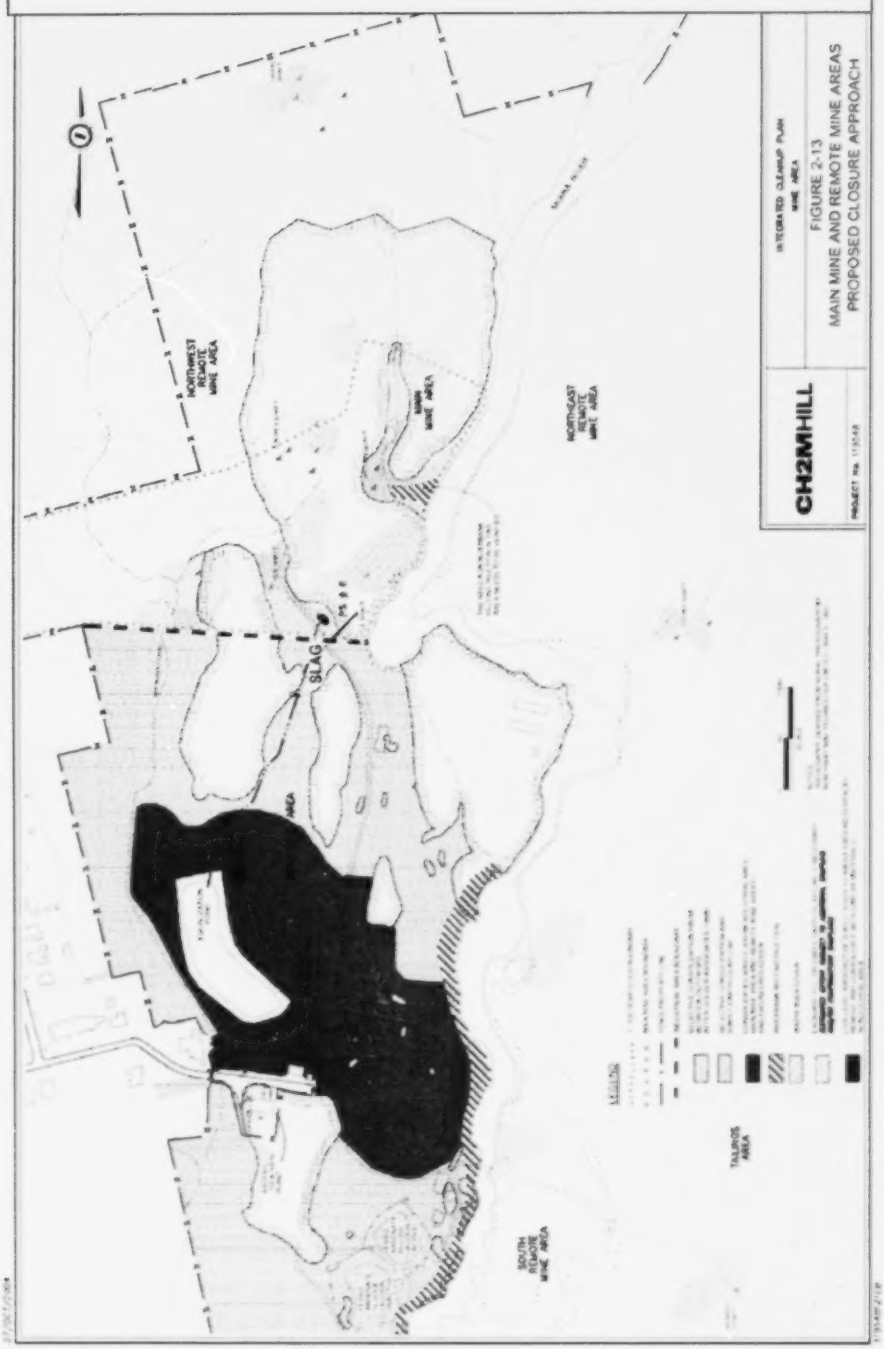
Cross-section of Engineered Cover, Industrial Area

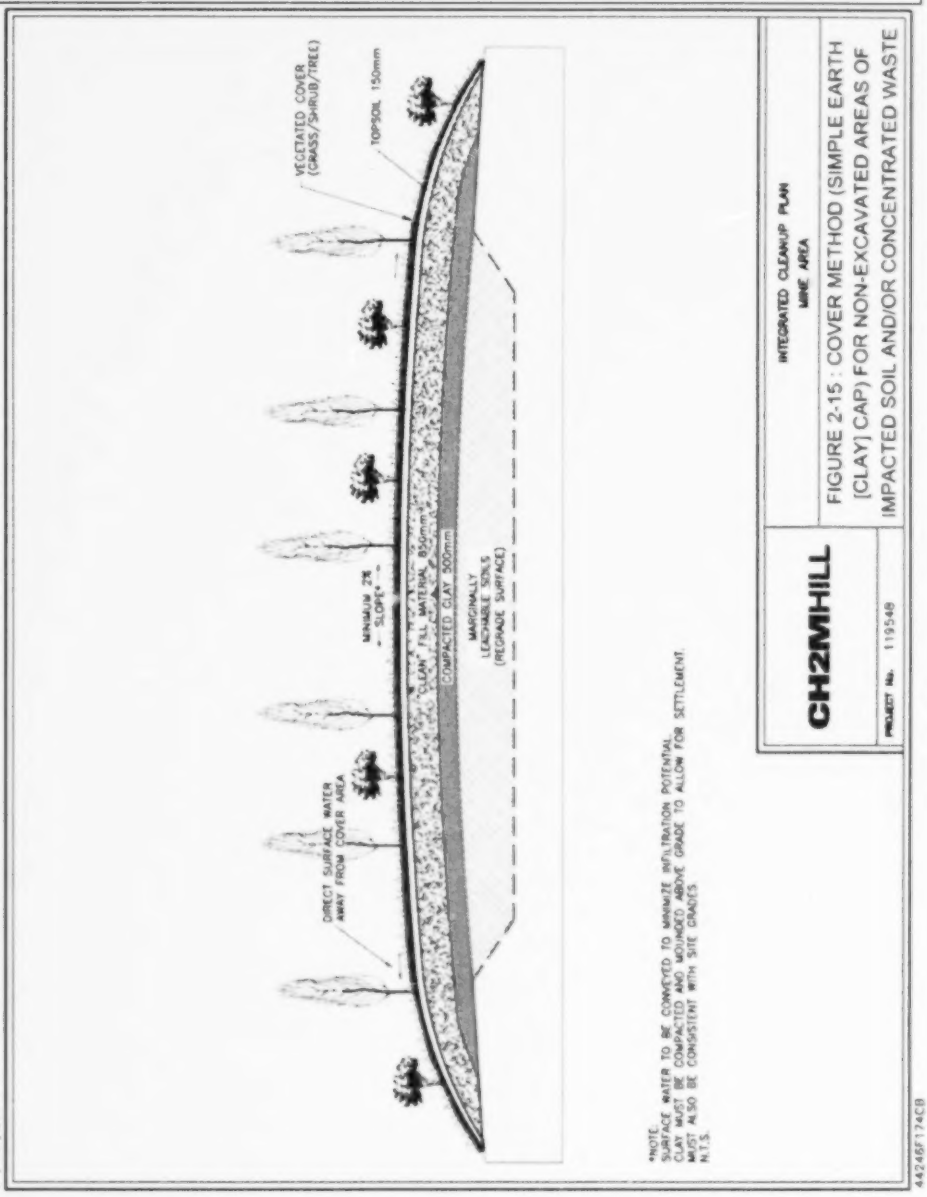


Overview, Mine Area

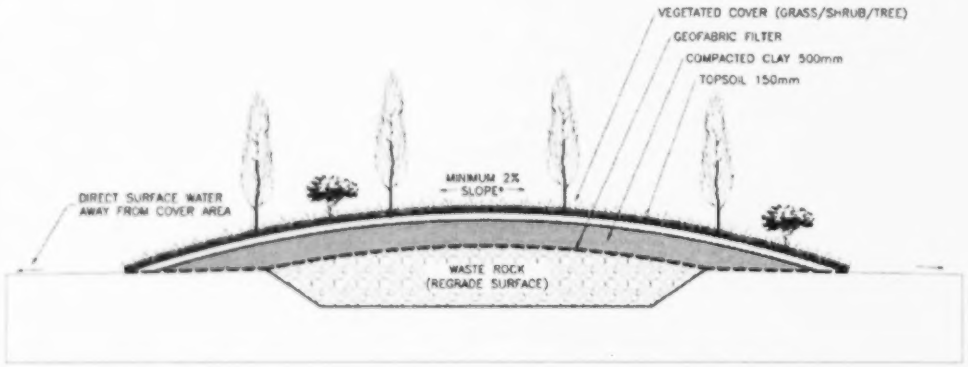
Overview, Mine Area



Cross-section of Engineered Clay Cap, Mine Area


VEGETATED COVER (GRASS/SHRUB/TREE)
TOPSOIL 150mm
DIRECT SURFACE WATER AWAY FROM COVER AREA
MINIMUM 2% SLOPE
CLEAN FILL MATERIAL 850mm
COMPACTED CLAY 500mm
MARGINALLY LEACHABLE SOILS (REGRADE SURFACE)
*NOTE:
SURFACE WATER TO BE CONVEYED TO MINIMIZE INFILTRATION POTENTIAL
CLAY MUST BE COMPACTED AND MOUNDED ABOVE GRADE TO ALLOW FOR SETTLEMENT.
MUST ALSO BE CONSISTENT WITH SITE GRADES
N.T.S.
INTEGRATED CLEANUP PLAN
MINE AREA
CH2MHILL
PROJECT No. 119548
FIGURE 2-15 : COVER METHOD (SIMPLE EARTH [CLAY] CAP) FOR NON-EXCAVATED AREAS OF IMPACTED SOIL AND/OR CONCENTRATED WASTE
27/OCT/2004
442465174CB

28/OCT/2004



*NOTE:
SURFACE WATER TO BE CONVEYED TO MINIMIZE INFILTRATION POTENTIAL.
CLAY MUST BE COMPACTED AND MOUNDED ABOVE GRADE TO ALLOW FOR SETTLEMENT.
MUST ALSO BE CONSISTENT WITH SITE GRADES.
N.T.S.

CH2MHILL

PROJECT No. 119548

INTEGRATED CLEANUP PLAN
MINE AREA

FIGURE 2-16
COVER METHOD (CLAY CAP) FOR WASTE ROCK

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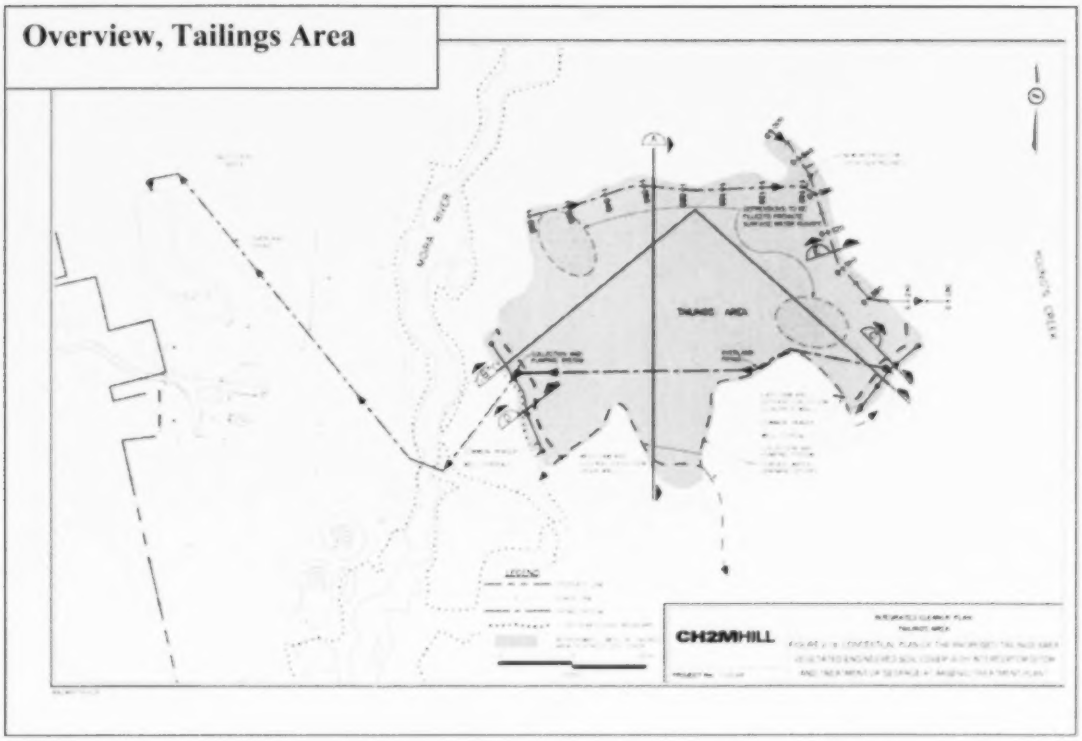
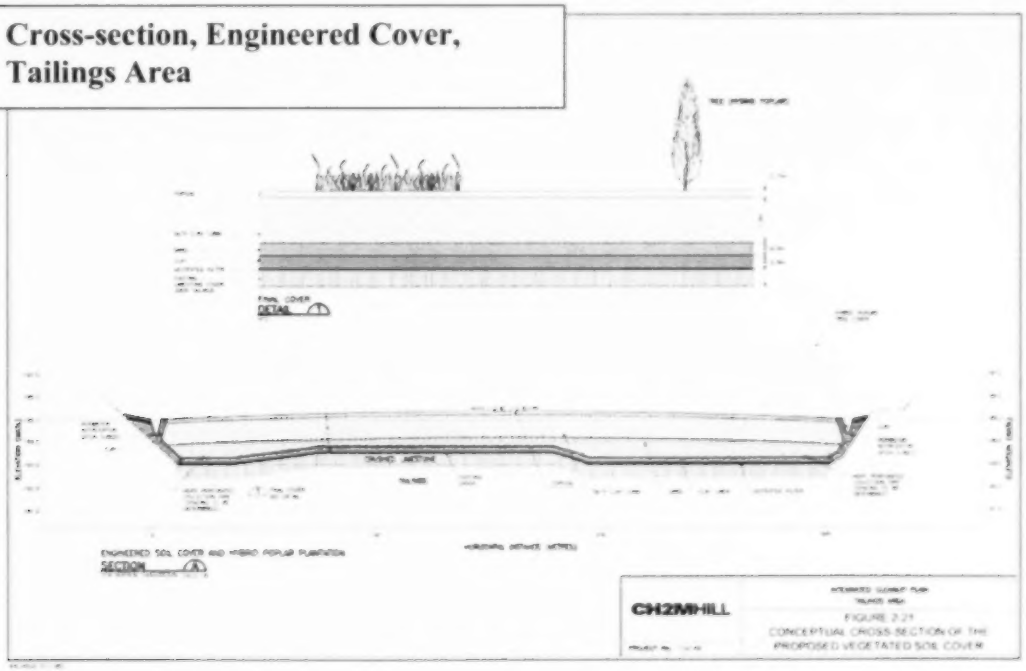
Cross-section of Engineered Clay Cap, Mine Area

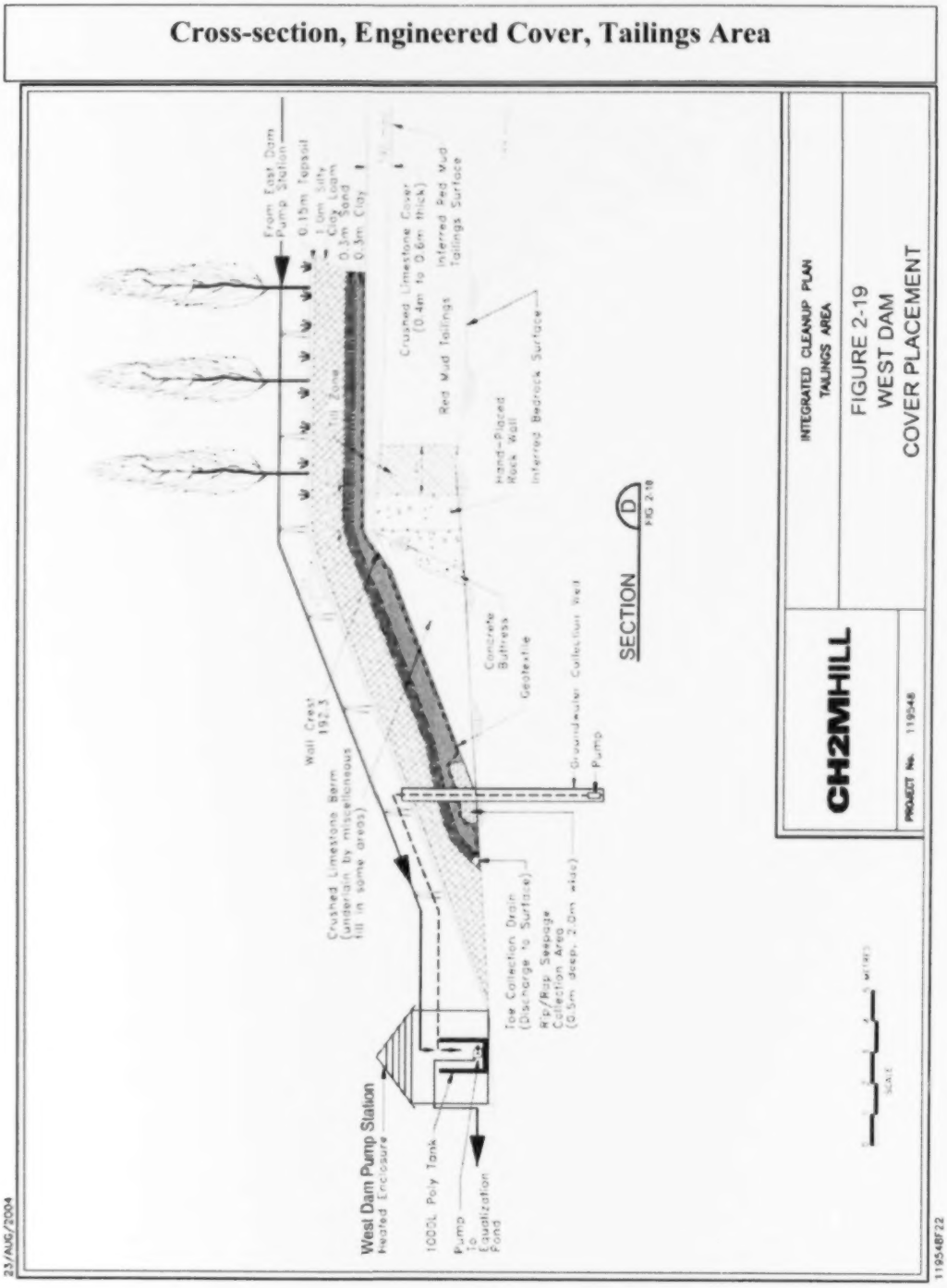
Overview, Tailings Area



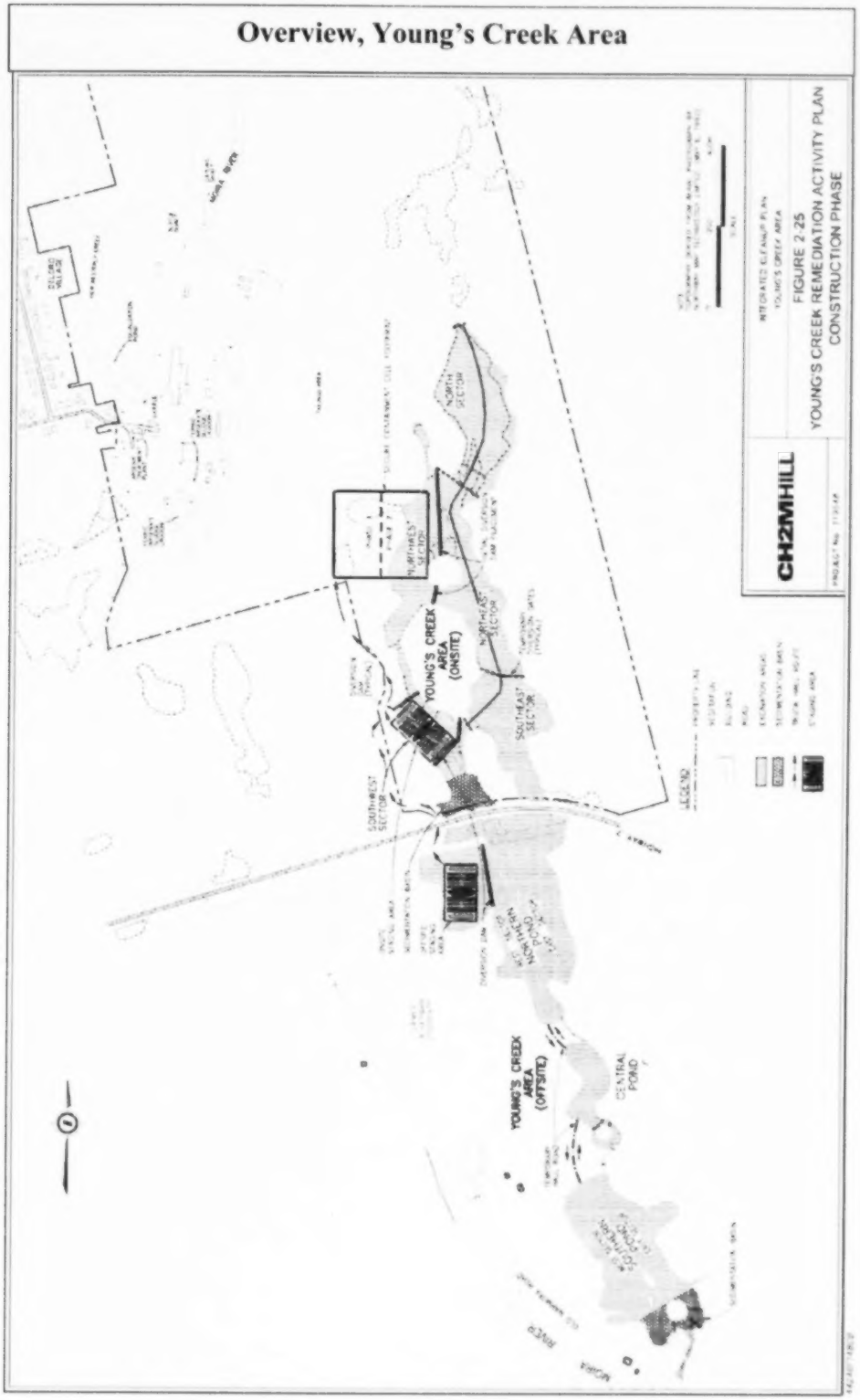
Cross-section, Engineered Cover, Tailings Area



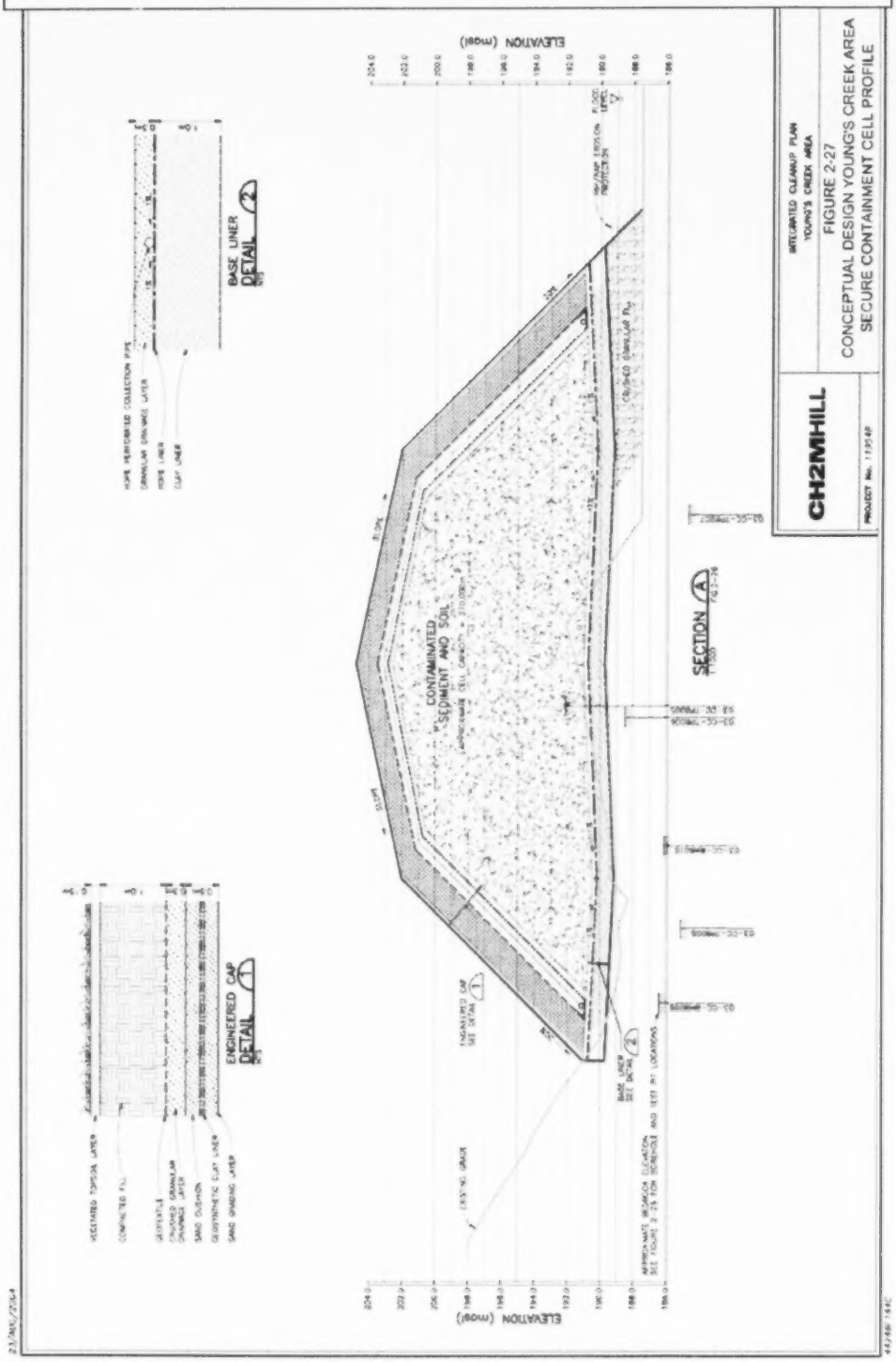
Cross-section, Engineered Cover, Tailings Area

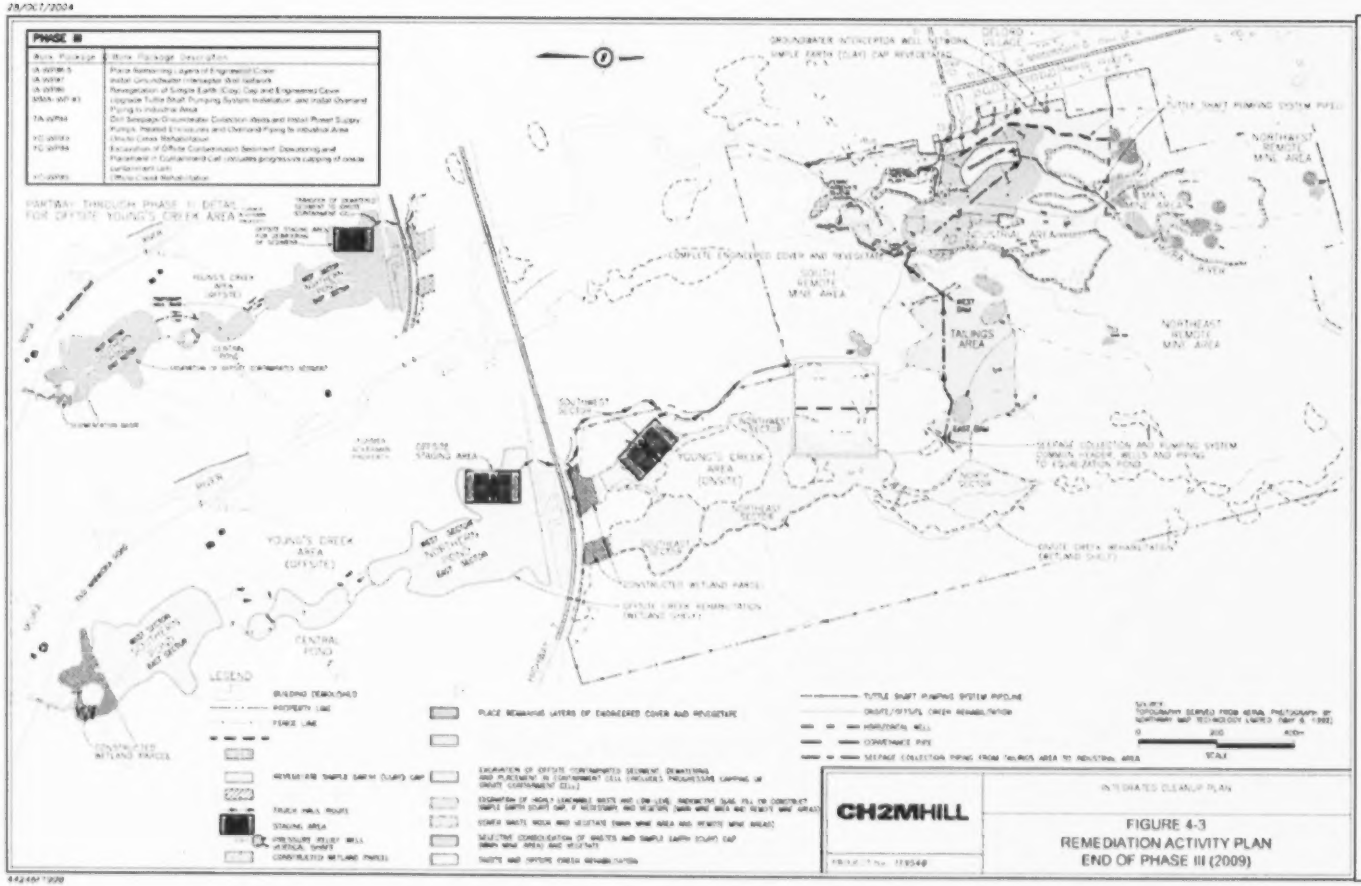


Overview, Young's Creek Area



Cross-section, Engineered Containment Cell, Young's Creek Area





Overview of Deloro Mine Site Post-Cleanup

Appendix B -- Health, Safety and Environmental Controls

Protection of public health and the environment is of paramount concern throughout the proposed cleanup of the Deloro Mine Site. Public health includes worker health and protection for individuals engaged in the cleanup activities, as well as protection for residents near the site. This includes people living in the Village of Deloro and downstream along the Moira River.

Environmental protection includes identifying risks related to potential releases during the cleanup whether through liquid releases to the Moira River, spillage of wastes during relocation, or dust/air emissions as a result of physical work at the site. The draft Integrated Cleanup Plan outlines the provisions that are proposed as part of this comprehensive plan. This includes provisions for containment, monitoring, and mitigation. A number of specific plans are proposed to address various aspects of the identified health, safety, and environmental risks.

Health and Safety - Prior to the implementation of the cleanup plan, an Environmental and Community Health Protection Plan will be developed. This plan will include measures to control dust, noise, odours, surface water runoff, surface water run-on, and erosion, as well as the use of appropriate equipment and personnel decontamination procedures.

Site Security and Safety - At present, the Deloro Mine Site and the Ontario Clean Water Agency (OCWA) compound are completely enclosed by a 7,606 m perimeter fence installed in March 2000. The majority of the chain link perimeter fence was installed to a height of 2.13 m, including 0.30 m of barbed wire. Adjacent to Highway # 7, the perimeter fence was installed to a height of 2.13 to 2.44 m, without barbed wire to satisfy Ministry of Transportation's Permit requirements.

There are seven points of entry to the site, mainly along the southern and western property boundaries, including four 9.0-m wide gates, one 6.0-m wide gate, one 1.2-m wide gate, and one recently installed gate near Highway # 7 to facilitate the installation of monitoring wells adjacent to Young's Creek. Access gates will remain closed if not in use during the day, and all gates will be closed and locked at the end of each working day to prevent public access to the site during remediation activities.

Access to the Industrial Area and portions of the Mine Area, along the west side of the Moira River, will be through the main site access gate near the Arsenic Treatment Plant. The existing onsite access road will be used for construction vehicles to access these areas.

Access to the Tailings Area and Young's Creek Area onsite will be via the access road off Highway # 7. Prior to work being conducted in the offsite portion of Young's Creek, a 1.8-m high chain link fence will be installed around the perimeter of the offsite portion of Young's Creek near key access points (i.e. road areas or other areas where a higher potential for public access exists). In other more remote and inaccessible areas, it will be determined during the final remedial design if temporary fencing is sufficient or required to further restrict public access to the work area. Any temporary perimeter security fencing erected during the implementation of the project will be removed.

Warning Signs - A group of three signs are affixed to the existing fence at distances varying between 50 m and 200 m, which read as follows:

- *Danger, No Trespassing, Positively No Admittance* (25 cm by 36 cm)
- *Caution, Radiation Area, Radioactive Materials, Authorized Personnel Only* (25 cm by 36 cm)
- *Mine Hazard Area, Danger: Every person who alters, impairs, or destroys this notice, this fence or any rehabilitation work made in accordance with Part VIII of the Mining Act, is guilty of an offence and, upon conviction, is liable to a fine of not more than $30,000* (30 cm by 30 cm)

During the construction phase of the project, signs will be used to caution the public along Highway # 7, in the Village of Deloro, and at site entrances. Signage may include "*Trucks Turning*" and other construction warning signs, as well as "*Danger – Access By Permit Only*" at access gates. Additionally, flagmen may be needed along Highway # 7 to control traffic when heavy machinery or large transport trucks enter or exit the highway.

Institutional Controls - Institutional controls at the site are as follows:

- Fencing exists on the perimeter of the Deloro Mine Site and access is restricted to authorized personnel.
- Signage exists on the perimeter fence as well as at the north and south approaches along the Moira River.
- The ministry will retain ownership and control of the site for the foreseeable future.
- Site conditions will be registered on title at the conclusion of the cleanup coincident with the issuance of a Record of Site Condition (RSC).

Noise Levels - To minimize the impact of potentially elevated sound levels on the local population, working hours will be scheduled to respect municipal by-laws regulating such activities. It is expected that sound levels will return to pre-construction conditions following the completion of the rehabilitation work.

For More Information on Health and Safety Issues - For more detailed information on health and safety considerations and plans, including the Environmental and Community Health Protection Plan, dust control and air monitoring, noise control, surface water protection, emergency preparedness, contamination control and other operational procedures, please refer to the *Deloro Mine Site Cleanup – Integrated Cleanup Plan, Draft Report*.

Monitoring Program - A comprehensive monitoring plan will be required to evaluate the effectiveness of the cleanup measures and to identify the need for maintenance tasks. The physical and chemical stability, water quality, and biological features at the Deloro Mine Site will be monitored in phases during three site rehabilitation time frames:

- Construction Phase
- Operation, maintenance, and monitoring Phase

Monitoring may occur daily, weekly, monthly, or at other specified intervals. Sampling frequency will be gradually reduced as monitoring programs confirm the effectiveness of the rehabilitation measures in reducing the flux of arsenic migrating to the Moira River.

The results of monitoring during construction activities will be documented in a Site Closure Report. During the operation, maintenance, and monitoring phase, annual reports will be prepared that document the results of monitoring activities for that year, discuss past trends in the data, and forecast trends into the future. The overall effectiveness of the cleanup measures will be examined in the annual reports.

Post-Closure Monitoring - The current monitoring program (surface water, groundwater, pumping system, wastewater treatment plant inlet and outlet) will be extended to monitor site conditions and the effectiveness of the site rehabilitation measures. This will include the existing monitoring wells, the surface water sampling stations and the operational sampling stations.

Sampling frequency will be reduced gradually once monitoring confirms the reductions of the loading of arsenic to the Moira River.

Data from the surface water monitoring stations will help determine the effectiveness of the new engineered covers and caps. Site monitoring requirements for the rehabilitated mine workings will continue in accordance with the January, 1994 *Deloro Mine Workings Closure Plan.*

Contingency Measures - The overall cleanup plan is intended to achieve a 90 percent reduction in arsenic loadings to the Moira River to achieve Provincial Water Quality Objectives (PWQOs) at the intersection of the Moira River and Highway # 7. Monitoring will be conducted to assess actual performance.

For More Information on Monitoring Programs

For more detailed information on the various components associated with the monitoring program please refer to the *Deloro Mine Site Cleanup – Integrated Cleanup Plan, Draft Report,* and the four Closure Plan reports.

Appendix C -- Potential Environmental and Socio-Economic Effects

Several environmental and socio-economic factors will likely be affected, to varying degrees, by the cleanup of the site. Such factors include, but are not limited to, the following:

Surface Water Drainage Patterns and Quality -- The draft cleanup plan includes construction of various types of engineered covers. These will cover several thousands of square meters of the site. These structures, combined with the construction of surface water interception ditches in the Industrial Area and the Tailings Area, and the reconstruction of the western bank of the Moira River will likely modify existing surface water drainage patterns. Since these structures will minimize contact between surface water and the wastes, surface water quality will improve significantly as a result of this work.

Groundwater Quality -- Groundwater is currently a significant contributor of contaminants to the Moira River; especially in the Industrial Area. The draft cleanup plan combines several features to minimize the release of contaminants to the environment. Following cleanup work, overall groundwater quality onsite should significantly improve over the long-term.

Air Quality -- Current air quality concerns at the site include potential wind erosion of the calcium arsenate/arsenite pile in the central portion of the Industrial Area. The draft cleanup plan calls for the isolation of the calcium arsenate/arsenite under an engineered cover, which will minimize the wind erosion. Air quality monitoring will be conducted during construction work to ensure the public and onsite workers are not exposed to substances that may pose risks to their health and safety.

Sound Levels -- Construction activities for the site cleanup will require the use of heavy earth moving equipment and trucks. To minimize the impact of potentially elevated sound levels on the local population, working hours will be scheduled to respect municipal by-laws regulating such activities. Sound levels will return to normal following the completion of cleanup work.

Visual Landscapes -- The current state of the local landscape of the Deloro Mine Site is significantly affected by the former mining/industrial use of the site. The overall appearance of the Deloro Mine Site will be significantly improved following the implementation of the cleanup plan.

Land Use -- The perimeter of the Deloro Mine Site is currently fenced to prevent public access to the site. Although the draft cleanup plan calls for the isolation of the onsite wastes and subsequent vegetation of engineered covers, it is unknown whether the current landuse of the Deloro Mine Site will be modified following completion of cleanup work. A heritage plan to preserve and promote the important natural, industrial, social and environmental history of the site is under development.

Vegetation - With the exception of the Main Mine, Industrial and Tailings Areas, the surface of the Deloro Mine Site is currently covered by "natural" vegetation. It is expected that this situation will not be significantly modified as a result of the cleanup. However, the plan includes the integration of grass and hybrid poplar trees as part of the engineered cover design for both

the Tailings and Industrial Areas. This is expected to represent a significant improvement of the vegetative cover of the Deloro Mine Site, in the medium-term, as it will take approximately seven years for the poplars to reach maturity.

Soil - Overall soil quality conditions will improve significantly as a result of the cleanup. Soils currently considered as "contaminated" will be consolidated and isolated under engineered covers in the Industrial and Mine Areas. Areas where contaminated soils will have been excavated will be covered with "clean" soils to promote the growth of vegetation.

Aquatic and Terrestrial Environments - The cleanup plan includes the reconstruction of the western bank of the Moira River in the Industrial Area and the removal of at least a portion of the impacted sediments in Young's Creek. The underlying principle of the plan is to substantially reduce the contaminant loads to the Moira River by isolating the wastes from wind, precipitation and groundwater. Consequently, aquatic environments in the immediate vicinity and downstream of the Deloro Mine Site are expected to benefit substantially from the cleanup. By isolating the wastes and vegetating engineered covers, terrestrial environments of the Deloro Mine Site are expected to improve substantially and to be able to support greater numbers of various species (fauna and flora) over the short to medium term.

Traffic Circulation – Cleanup work is expected to have an impact on local traffic circulation during the active construction period. Measures will be implemented to minimize that impact on public roads. Temporary roads will be constructed on the Deloro Mine Site to allow vehicular circulation on the site itself. The increase in traffic on the roads of the Village of Deloro should be limited to delivery of special materials (if required) and to the daily arrival and departure of site workers for the duration of the remediation.

Residential and Local Business Activity - Like any other important construction project, the cleanup will likely have an impact on the residential activities in the Village of Deloro. As indicated above, higher sound levels and greater transient traffic activity are to be expected during the construction period. Measures will be implemented to reduce these potential impacts to a minimum to respect municipal by-laws dealing with these issues.

The Deloro Mine Site Cleanup Project will require investments of tens of millions of dollars. The project is expected to have a positive impact on local and regional businesses, whether directly or indirectly. Particular segments of the regional economy that will likely benefit from the remediation project are as follows: quarries, earth moving contractors and equipment rental, fuel depots, lodging and food industry, etc. A detailed assessment of the possible interactions between the project activities and the environmental and socio-economic components, and the identification of measures to mitigate potential adverse impacts will be undertaken as part of the environmental assessment for this project.

Appendix D– Characteristics of the Deloro Mine Site

Physiography - The site is located mainly in the Algonquin Highland physiographic region, an area of Precambrian Shield notable for rough relief and shallow, nutrient-poor, droughty soils as well as a climate harsher than in many other parts of southern Ontario. Sandy texture, acidity and low fertility in this area of granite bedrock all contribute to low productivity on limited deep soil. The area is largely non-agricultural because of the rock outcrop and associated shallow soil, rough topography, stones, and swamp.

The physiography of the Deloro Mine Site is characterized by an irregular bedrock surface with numerous outcroppings, primarily toward the north end of the site and along the Moira River. The latter flows through the Deloro Mine Site. The reach of the Moira that intersects the Industrial Area comes into contact with a complex geological and hydrogeological system. In general, the site's ground surface slopes to the south and towards the Moira River.

Geology - The site is located at the contact between Precambrian basement rocks and younger, Palaeozoic sedimentary rocks. Bedrock is exposed primarily at the north end of the site and along the Moira River, which passes through the former mine property. Bedrock outcrops also frequently occur over the area north and northeast of the Industrial Area, where the main mining activities and early milling/refinery operations took place. The bedrock over much of the site is covered by natural overburden, clay fill, building rubble, tailings, slag, or a mixture of all of these. The natural overburden consists primarily of silty clay with minor amounts of silty sand and peat. These native soils are generally found in areas of low topography. In the Industrial Area, fill comprises up to 3 m in the overburden across most of this area, with localized pockets of calcium arsenate and ferric hydroxide (red mud) tailings.

Hydrology - The Deloro site is situated in the central portion of the Moira River Basin. The Moira River drains an area of approximately 2,750 km^2 and flows into the Bay of Quinte on the northern shore of Lake Ontario. The main hydrological feature of the Deloro Mine Site is the Moira River, which flows through the Deloro Mine Site roughly bisecting the property. The river enters the property along the northern boundary and leaves the property at the southwest corner. On the mine site property, the Moira River flows through an area of exposed bedrock and is characterized by a series of rapids, riffle and pool sequences incised over a substrate of bedrock and unconsolidated alluvium.

The surface topography and drainage have been extensively altered over the more than 100 years of mining and refining activity on the site. Surface drainage in the western portion of the site (i.e. west of the Moira River) occurs typically from the west to the east (i.e. towards the Moira River). For a limited fraction of that portion (i.e. the northwestern section), surface drainage is directed to a constructed ditch, referred to as New Westerly Creek, which grades southwards along the western property boundary. Surface drainage in the eastern portion of the site (i.e. east of the Moira River) is controlled by a north-south trending ridge of high ground that bisects the lands in question. Surface waters west of the ridge drain westward to the Moira River, whereas surface waters east of the ridge drain to Young's Creek.

Floodplain mapping predicts that in the event of a 100-year storm the red mud tailings area, one of the inactive sludge lagoons (the former north nickel pond) and the active ferric arsenate sludge lagoon would remain above the flood waters. However, the third inactive sludge pond (the former south nickel pond) and the majority of the sediments within the Young's Creek Area will be submerged.

Hydrogeology - The hydrogeology of the Deloro site is complex as a result of both natural factors and historical industrial development. The following unique factors influence the groundwater regime at the site:

- Location of the Precambrian-Palaeozoic bedrock contact axis
- Changes in the texture, origin and thickness of overburden at the site which, as noted, includes fill, industrial wastes and mine tailings
- Fractured bedrock properties that vary across the site according to bedrock age, type, location, and the degree of human disturbance from blasting and underground mine development
- Rapidly changing topography that varies from elevated bedrock ridges, to low-lying wetlands, to intervening broad, flat areas containing industrial wastes and mine tailings
- Mine shaft pumping and drainage collection systems associated with the onsite Arsenic Treatment Plant

Hydrogeological conditions are better defined in the Industrial Area of the Deloro Mine Site. This reflects the environmental concerns raised by the historical activities conducted in that area. The hydrogeology at the site is also incongruous, with several flow divides that are both natural and constructed. The effect of the groundwater pumping system and mine galleries in conjunction with bedrock outcrops results in an erratic flow system over most of the Deloro Mine Site. However, based on information presented, the overall groundwater flow patterns at the site are from the northwest to southeast on the lands located to the west of the Moira River and from the northeast to the southwest for the lands located east of the Moira River, with the exception of the lands located in the vicinity (i.e. west and north) of Young's Creek, where groundwater likely flows towards Young's Creek.

At the Industrial Area, groundwater flow is locally altered to some extent by constructed features such as the cut-off wall located near the west bank of the Moira River, drainage collection systems and several ponds. There are numerous abandoned buildings and structures that also affect surface and, to a lesser extent, groundwater flow. During the construction of the equalization pond, it was reported that unexpected soil conditions underlying the pond precluded the complete prevention of exfiltration of waters from the pond. Therefore, the equalization pond may be recharging the groundwater and affecting local groundwater flow direction.

Groundwater flows beneath the surface through overburden, bedrock, and/or a combination of both. In the overburden, groundwater flows are concentrated along more permeable material usually lying directly on the bedrock surface. In the bedrock, groundwater flows occur primarily along fractures, bedding planes and similar geological features. Fracture frequency and aperture generally decrease with depth; therefore, groundwater flow through bedrock is expected to be

greater in the shallow bedrock. Bedrock flow patterns are influenced by zones of higher hydraulic conductivity associated with natural faulting and/or folding.

In the overburden, an apparent groundwater divide exists between the old laboratory building and the former primary treatment plant. This divide is probably the result of groundwater being pumped from Pumping Station 5. If the pump does not run sufficiently long, the groundwater levels in the area of the equalization storage basin would likely rise enough for groundwater to flow southeast toward the Moira River.

A groundwater divide exists in the bedrock between the high ground at the former primary treatment plant and the powerhouse to the north. East of this divide, groundwater flows more or less directly to the Moira River. West of this divide, groundwater flows in the bedrock along a longer flow path, eventually discharging to the Moira River at the southeast sector of the Industrial Area.

Flora Communities - The plant communities on the site are fairly typical for an area that is intermediate in disturbance and has a geographical location between northern and southern Ontario. No provincially rare plant communities were found on the site; nor were any provincially or regionally rare, threatened or endangered species of plants found. The highest Floristic Quality Index (FQI) is found in marshes and in mixed and deciduous forest, particularly on the northern part of the site.

Aquatic Ecology - All watercourses within the vicinity of the Deloro Mine Site sampled for fisheries (which were all within the area of potential contamination associated with historic mining activities) can be classified as fish habitat. Field observations indicate that the water bodies abutting the Deloro Mine Site support an assemblage of warm and cool water fish species. Habitat conditions are suitable for a number of fish species. Some species such as largemouth and smallmouth bass are valued as game fish and are present at various locations along the Moira River. Forage fish such as minnows were abundant in marshes downstream of the site. These watercourses support a fishery that is economically important as bait, forage fish and game fish. No threatened or endangered species of fish were found.

Terrestrial Ecology - Wildlife species found are typical of areas of extensive forest in eastern Ontario. There were no provincially or regionally rare, threatened or endangered species of animal life found. None of the wildlife species found at the site have highly specific requirements for habitat, which is likely to become scarce in the area. Many species are already becoming scarce or have been extirpated (locally extinct) in highly urbanized parts of southern Ontario (e.g. wood warblers, black bear) as a result of forest fragmentation, destruction of habitat and urbanization. Therefore, preservation of habitat for these species is unlikely to become a concern at the site in the near future, since a large proportion of the site district is already forested.

Wetlands - Wetlands are mainly confined to Young's Creek, which enters the site at its northeast corner and flows south along the eastern side of the Tailings Area, after which it splits into two wide floodplain channels (the east and west arms). Wetland communities can be found in a narrow band along and in small patches within the Moira River. There are no large wetlands

associated with the Moira River directly on the Deloro Mine Site but there are several immediately south of the site. The Deloro Wetland Complex is a Class 2 provincially significant wetland.

Provincially Significant Areas - An ecological inventory completed at the site indicated that the site is located in an area noted for shallow till and bedrock ridges, till moraines, limestone plain, peat and muck deposits, eskers, and drumlins.

Significant natural features not protected by provincial parks in this area are forested Precambrian bedrock ridges and undeveloped lake shorelines. The Moira River between Chisholm and Latta and near the mouth at Moira Lake contains large provincially significant areas of natural and scientific interest; however, none of the features that contribute to this designation (all related to limestone) are noted within the site.

In 1990, the onsite and offsite (south of Highway # 7) portions of Young's Creek were designated as Provincially Significant Wetlands (PSW). The Deloro Wetland Complex was re-evaluated by Snider's Ecological Services in 2000 as a Class 2 PSW. No provincially significant species of amphibians, reptiles, birds, mammals, or plants were observed in the Deloro Wetland Complex or associated uplands.

Appendix E – Ministry of the Environment Accomplishments

Since assuming control of the Deloro Mine Site as remediator of last resort, the ministry has taken a number of actions that have resulted in an 80 per cent reduction in the amount of arsenic contamination coming off the site. The draft cleanup plan will deal with the remaining 20 per cent of the problem.

Construction of an Arsenic Treatment Plant - When the ministry took control of the site in 1979, the most significant problem was arsenic contamination to the Moira River. Arsenic was leaching into the river at a rate of approximately 52.1 kilograms a day. In 1983 the ministry built an extensive water collection, storage and treatment facility to remove arsenic and other metals from groundwater and surface water runoff.

An 80-metre concrete cut-off dike was built on the west bank of the Moira River to intercept the natural flow of groundwater, to divert it from joining the river, and to treat the contaminated water. Four pumping stations carried groundwater from the site to a storage pond. The water was then treated to remove arsenic and other heavy metals. The results were immediate. Arsenic loadings to the Moira River fell dramatically, lowering the annual average daily arsenic discharge from 52.1 kg/d to less than 10 kg/d. The plant has been working ever since, and is now operated by the Ontario Clean Water Agency (OCWA). This system operates under a Certificate of Approval issued by the province.

Pumping Station 1 is located at the south end of the concrete cut-off dike, east of the former primary refinery building. Pumping Station 2 is at the north end of the concrete cut-off dike. This pump system collects and feeds water to the equalization pond. Pumping Station 3 is located at the south end of the north (or first ferric arsenate) sludge lagoon. This station conveys drainage water from the ferric arsenate sludge lagoon and from collector tiles that intercept the groundwater from the south end of the site extending from the pump to the northwest corner of the castings building. Pumping Station 4 is located at the southeast corner of the calcium arsenate/arsenite storage area.

A fifth pumping station was added south of the equalization pond in 1984 to address suspected groundwater flow toward the wastewater treatment building. Pumping Station 5 is an 8 m deep well, approximately 25 m southeast of the equalization pond that was put in place to intercept groundwater believed to be influencing the water quality south of the plant. The water from Pumping Stations 1 to 5 is routed to the equalization pond.

Pumping Station 6 was established in 1985 to convey Tuttle Shaft seepage to the equalization pond via an aboveground discharge line. The Tuttle Shaft pumping station is only operated during the summer months.

From the equalization pond, collected waters are fed to the treatment plant equipped with a ferric contact reactor, a lime pH adjustment reactor, and a 30-tonne hydrated lime storage silo. From the lime pH adjustment, effluent travels through a 200-mm line to a polymer addition tank to precipitate out arsenic and other contaminants. Finally, the water flows into a large circular collector (i.e. clarifier) in which the precipitates settle out and form a ferric arsenate sludge. An

air compressor runs two pumps that direct the resulting sludge into the ferric arsenate sludge lagoon, located at the south end of the Industrial Area, for dewatering.

The wastewater treatment process is monitored by a pH probe, turbidity meter and suspended solids meter. After treatment, the effluent water is pumped into the make-up water tank or is allowed to outfall into New Westerly Creek, while the sludge from the treatment process is directed to a sludge storage lagoon.

Extensive Ground and Surface Water Monitoring Network - An extensive sampling network was put in place to monitor surface and groundwater quality on and off the site. Collection stations on the Moira River and Young's Creek provide information on surface water, while monitoring wells on the property are used to assess groundwater contamination. Depending on the location of the sampling station, samples are taken hourly, daily, weekly, monthly or quarterly. Samples are analyzed at the on-site lab facilities.

A program including the monitoring of the treatment plant influent and effluent and the groundwater pumping stations was also developed. Annual reports are prepared and submitted by the ministry.

Ongoing monitoring shows that arsenic concentrations in the Moira River have been substantially reduced since the ministry took control of the site. In 1979, the annual average loading of arsenic to the river was 52.1 kg/day. Since the Arsenic Treatment Plant was put in operation in 1983, the arsenic going into the river has been reduced by more than 80 per cent, to an average amount of less than 10 kg/day.

Locating and Sealing Abandoned Mine Shafts - In May 1992, a plan to address mine hazards at the Deloro site was developed with the Ontario Ministry of Northern Development and Mines (MNDM) based on an in-depth review of the mine hazards followed by a survey to locate all mine workings at the site. Investigation activities in the mine area began in July 1992 with the review and analysis of all available and pertinent archival and historical information. An extensive field survey commenced in September 1992 and resulted in the identification and mapping of approximately 110 mining-related features. Ground-penetrating radar was carried out in November and December 1992 to locate suspected underground workings.

In June/July 1993, air-track drilling was carried out to quantify ground-penetrating radar results and to determine the thickness of rock and overburden. Diamond drilling to study the rock mechanics and to determine subsurface geological conditions with respect to existing crown pillars was completed from August to October 1993. Safe access routes into the mine areas on both sides of the river were developed in September and October 1993 and the backfilling of the identified shafts, pits, stopes, and adits was carried out from October 1993 to January 1994. By 1995, all known mine shafts had been located, secured, and either fitted with reinforced concrete shaft caps, or backfilled according to the specifications of MNDM.

Covering Tailings - In 1986/87, approximately 8 ha of ferric hydroxide tailings (red mud), the arsenic contaminated by-product of the smelting process, located on the eastern side of the Moira

River (i.e. the Tailings Area) were covered with crushed limestone. The red mud tailings were covered to a depth of 0.5 metres with approximately 76,000 tonnes of crushed limestone in order to eliminate wind and surface water erosion, elevate the pH of the tailings (as it was thought at the time that the tailings were acid generating) and stabilize the two containment dams.

Simultaneously, measures were undertaken to raise the level of the containment dams and to incorporate filter-graded material. Two engineered catchment basins were constructed downstream to intercept seepage from the dams.

Removing Treatment Plant Sludge - Removal of the dissolved arsenic from the collected groundwater results in the generation of an arsenic-rich ferric arsenate sludge that accumulates in the under-drained lagoon located in the southernmost section of the Industrial Area. As facilities do not currently exist for onsite long-term storage of the sludge, it has been the practice to periodically remove sludge for offsite disposal at a licenced, secure, hazardous waste containment system. For example, approximately 2,000 metric tonnes of sludge were transported to a secure hazardous waste landfill site in the Province of Quebec for treatment and disposal in early 2002.

Demolishing Contaminated Buildings - To address other major sources of arsenic on the site, the ministry demolished a number of contaminated industrial buildings formerly used for collecting and processing arsenic during and following smelting (i.e. pesticides building, arsenic baghouse). The areas where these structures stood were regraded and seeded.

Defining the Extent of the Environmental Problem – Once the mine shafts were sealed and the site was safe for workers, the ministry could proceed with the necessary field work to fill in information gaps, and determine the best options for the final cleanup, containment and management of onsite contaminants. An engineering consulting firm was hired in April 1997 and in-depth field investigations began in June of that year. Problems that had been identified earlier were now studied in greater detail.

As part of the overall cleanup project, the MOE committed to defining the extent of any offsite environmental problems associated with the Deloro Mine Site, including the potential for contamination in the former Village of Deloro and in the Moira River watershed. This lead to two comprehensive studies that are outlined below.

Soil samples taken beyond the boundaries of the mine site in late 1997 showed the presence of arsenic, cobalt, nickel, silver, and other heavy metals. Airborne pollutants released during nearly 100 years of mining and refining are the most likely cause of this contamination. These preliminary findings were reviewed with the local Medical Officer of Health and, after consultation, the MOE concluded there was a need for further investigation.

Deloro Village Environmental Health Risk Study - In 1998, the MOE, in co-operation with the Hastings and Prince Edward Counties Health Unit and the Ministry of Health, launched the Deloro Village Environmental Health Risk Study. This comprehensive, multi-media study examined total exposure to contaminants through air, soil, dust, drinking water, and food to

determine if elevated levels of contaminants were present. It also examined the potential for health risks in the community. The final report, released in July 1999, found the Village is a safe community and there is no significant link between contamination and health risk for the people living in Deloro.

Moira River Study - In December 1998, the MOE also launched a detailed study of the Moira River system to examine the environmental impact of historical contamination from the abandoned mine site on the Moira River. The draft report, released for public consultation in August 2000, and the final report, released in April 2001, found that, despite the presence of historical contamination in the river system, there is no adverse effect on aquatic life and little or no health concern for residents and cottagers downstream of the Deloro site.

Appendix F -- CH2MHILL Technical Investigations

Below is a partial listing of CH2MHILL technical investigations.

#	Title	Date
1	Deloro Mine Rehabilitation Project River Diversion Feasibility Assessment	October 1998
2	Deloro Mine Rehabilitation Project Development of Closure Criteria	October 1998
3	Deloro Mine Rehabilitation Project Potential for Metal Recovery from the Deloro Mine Wastes	October 1998
4	Survey of Moira River Water Use – Update	October 1998
5	Deloro Mine Site Rehabilitation Floodplain Mapping	November 1998
6	Deloro Mine Site Rehabilitation Project Assessment of East Bank Seep – Moira River	November 1998
7	Deloro Mine Site Rehabilitation Ecological Inventory	February 1999
8	Deloro Mine Rehabilitation Project Extent and Character of Radioactive Materials	June 1999
9	Topographic Survey of Waste Isolation Areas	March 2001
10	Geotechnical Investigation of Subsurface Conditions for the Proposed Groundwater Cross-Flow Interceptor	March 2001
11	Moira River Sediment Survey	March 2001
12	Onsite Delineation of Impacted Soil – Summary Report	May 2001
13	Delineation of Young's Creek Sediments – Deloro Mine Site	May 2001
14	Trial Excavation of Frozen Young's Creek Sediments	June 2001
15	Geotechnical Investigation of Subsurface Conditions for the Young's Creek Area	June 2001
16	Deloro Mine Rehabilitation Project Engineering Assessment of the Deloro Dam	June 2001
17	Monitoring Wells Adjacent to Tuttle Shaft	August 2001

18	Deloro Mine Rehabilitation Project General Health and Safety Plan	January 2002
19	Deloro Mine Rehabilitation Project Onsite Data Summary	February 2002
20	Deloro Mine Rehabilitation Project Riverbank Reconstruction Alternatives for the Industrial Area	March 2002
21	Deloro Mine Rehabilitation Project Natural Treatment Technology Feasibility for Tailings Leachate Contaminant Reduction	March 2002
22	Deloro Mine Rehabilitation Project Development of a Sitewide Water and Load Balance	March 2002
23	Deloro Mine Rehabilitation Project Feasibility Study for a Combined Soil Cover and Poplar Tree Cap in the Tailings Area	May 2002
24	Deloro Mine Rehabilitation Project Investitagion of Mine, Tailings and Young's Creek Areas	July 2002
25	Deloro Mine Site Rehabilitation Project Assessment and Reconstruction of Deloro Mine Site Bridge	June 2002
26	Deloro Mine Site Cleanup Delineation of Offsite Sediments and Clay Deposits in Young's Creek and Assessment of Beaver Dams	March 2003
27a	Deloro Mine Site Cleanup Deloro Mine Site Site-Specific Risk Assessment	Under review
27b	Deloro Mine Site Cleanup Offsite Young's Creek Site-Specific Risk Assessment	Under review

Appendix G - Preserving Deloro's Heritage

The Deloro Mine Site has a rich and important history. From its place in the Madoc Gold Rush, to its innovations in creating and producing metals and alloys, Deloro played a key role in the history of mining and industry in Canada. There are many stories to be told about the Deloro Mine Site, its geology, its industry, its innovation and its people. There are also important lessons to be learned about the consequences of reckless exploitation of the environment - a legacy of our uninformed past - and the extensive cleanup that must follow. Telling those stories, and preserving that history has been an important topic of discussion over the past two years.

As the ministry draws closer to completion of cleanup plans, it is important to consider and plan for the future uses of the mine site. Heritage preservation and environmental education are possible uses. In September 2002 the ministry initiated a dialogue on heritage issues with the Public Liaison Committee. The committee was unanimous in its agreement that any recognition and preservation of Deloro's important history would be positive for the community.

Since the ministry's mandate is for environmental cleanup of the site, it cannot take the lead in long-term commemoration efforts. Community leadership is encouraged. However, the ministry did commit to seek out heritage groups and organizations that could help the community, and to bring those people together for a meaningful discussion of possible next steps.

In July 2003 the ministry facilitated that meeting at the Deloro Community Centre. In attendance were representatives from:

- The Ontario Ministry of Culture
- Ontario Historical Society
- Mining Association of Canada
- The Ontario Mining Association
- Hastings County Historical Society
- Marmora Historical Foundation
- Queen's University
- North Hastings Heritage Museum
- Quinte Watershed Clean-up
- Municipality of Marmora and Lake and
- local residents.

While the first priority is to complete the cleanup of the mine site, the ministry is working with the community, heritage organizations, and other provincial ministries to preserve and promote the important natural, industrial, social and environmental history of the Deloro Mine Site.

The ministry engaged the services of the Architectural Conservancy of Ontario's (ACO) Preservation Works! program, to provide a heritage appraisal for the site.

A heritage plan will be developed for the site that will include preservation of several remaining structures on the site, and the possible creation of on-site walking trails and commemorative plaques once the cleanup is complete.

Deloro Mine Site Heritage Initiative Committee

This group of local area residents formed in July 2003 to help preserve and promote Deloro's important history. For more information please contact: Linda Bracken, 147 Rockhaven Road, R.R. 2 Marmora, Ontario, K0K 2M0

Phone/fax: 613-472-3563.
E-mail: l.bracken@sympatico.ca

Appendix H --List of Acronyms

ATP	Arsenic Treatment Plant
C of A	Certificate of Approval
CEAA	Canadian Environmental Assessment Act
CNSC	Canadian Nuclear Safety Commission
DFO	Department of Fisheries and Oceans
EA	Environmental Assessment
EAA	Environmental Assessment Act
EPA	Environmental Protection Act
GIWN	Groundwater Interceptor Well Network
GUCSO	Guideline for Use at Contaminated Sites in Ontario
MNDM	Ministry of Northern Development and Mines
MNR	Ministry of Natural Resources
MOE	Ministry of the Environment
MTC	MOE Technical Committee
OCWA	Ontario Clean Water Agency
OMM	Operation, Maintenance, and Monitoring
PLC	Public Liaison Committee
PWQO	Provincial Water Quality Objectives
SSRA	Site Specific Risk Assessment
TLC	Technical Liaison Committee
USEPA	U.S. Environmental Protection Agency

Appendix I - Project Liaison Committees

Public Liaison Committee

Since 1997, the ministry has been meeting regularly with three project liaison committees to keep them informed and to gather input and comments on reports and recommendations.

This consultation process helps to inform and guide the ministry's remediation plans and work at the site, and downriver. Two of these are external committees -- the Deloro Public Liaison Committee and the Technical Liaison Committee. The third committee is a Ministry of the Environment Technical Committee.

The Public Liaison Committee includes representatives from municipal, environmental and public stakeholder groups in the Moira River area:

- Village of Deloro (residents)
- Quinte Watershed Clean-up
- Quinte Field Naturalists
- Quinte Conservation/Moira River Conservation Authority
- Moira Lake Property Owners' Association
- Stoco Lake (residents)
- Municipality of Marmora and Lake
- Municipality of Centre Hastings
- Mohawks of the Bay of Quinte
- Marmora Historical Foundation
- Deloro Heritage Initiative Committee
- City of Belleville

Technical Liaison Committee

The members of the Technical Liaison Committee represent municipal, provincial and federal agencies with an interest in, or regulatory involvement with, the site:

- Ministry of the Environment
- Ministry of Northern Development & Mines
- Environment Canada
- Department of Fisheries and Oceans
- Ministry of Natural Resources
- Hastings and Prince Edward Counties Health Unit
- Ministry of Labour
- Canadian Coast Guard
- Atomic Energy of Canada Limited, Low Level Radioactive Waste Management Office
- Ministry of Health and Long-Term Care
- Quinte Conservation/Moira River Conservation Authority
- Ontario Clean Water Agency
- Canadian Nuclear Safety Commission

Ministry of the Environment (MOE) Technical Committee

This internal Technical Committee made up of representatives from the ministry's technical branches. Representatives provide advice on technical and regulatory requirements:

- Eastern Region Water Resources Unit
- Eastern Region Abatement Section
- Standards Development Branch
- Water Policy Branch
- Environmental Assessment and Approvals Branch
- Environmental Cleanup Fund
- Legal Services Branch